

POLICY RESEARCH WORKING PAPER

WPS1472

1472

Fiscal and Monetary Contraction in Chile

A Rational-Expectations Approach

Klaus Schmidt-Hebbel

Luis Servén

To analyze the probable macroeconomic impact of fiscal and monetary retrenchment in Chile, an open-economy, dynamic rational-expectations macroeconomic model is applied to data for Chile.



Summary findings

For the past two decades, Chile has consistently pursued a course of macroeconomic stabilization and deep economic reform. But in recent years, real exchange rate appreciation and persistent moderate inflation have become key concerns for Chilean policymakers, suggesting the need for further fiscal and monetary retrenchment.

Using an open-economy, dynamic rational-expectations macroeconomic model applied to Chile, Schmidt-Hebbel and Servén analyze and quantify the macroeconomic impact of fiscal and monetary retrenchment.

Several features of the model are essential for a realistic assessment of the effects of fiscal and monetary policy shifts in Chile: backward indexation of wages, consolidation of the central bank and the general government, and the coexistence of (1) liquidity-constrained consumers and firms with (2) unconstrained

agents whose consumption and investment decisions reflect intertemporal optimization with perfect foresight. This framework makes it possible to distinguish meaningfully between permanent and transitory policy changes, as well as between changes that are or are not anticipated.

Simulations show that a balanced-budget fiscal contraction leads to a modest real depreciation, which is sharper in the short term (especially if the contraction is temporary). At the same time, this type of fiscal retrenchment causes a temporary deterioration of the current account.

An orthodox money-based disinflation implemented by halving the growth rate of base money leads to a sharp real appreciation in the near term, with steep output and employment costs in the short run, but it also causes a transitory improvement in the current account.

This paper — a product of the Macroeconomics and Growth Division, Policy Research Department — is part of a larger effort in the department to model macroeconomic policy in developing countries. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Emily Khine, room N11-061, extension 37471 (39 pages). June 1995.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be used and cited accordingly. The findings, interpretations, and conclusions are the authors' own and should not be attributed to the World Bank, its Executive Board of Directors, or any of its member countries.

FISCAL AND MONETARY CONTRACTION IN CHILE: A RATIONAL-EXPECTATIONS APPROACH*

by

Klaus Schmidt-Hebbel and Luis Servén

JEL Classification: E13, E63, F41, O54

The World Bank

* We are particularly indebted to Peter Montiel for excellent comments and suggestions to a preliminary draft. We thank Luis Felipe Lagos, Guillermo LeFort, Claudio Sapelli and participants at the XIIIth Latin American Meetings of the Econometric Society (Caracas, August 1994) and at the Chile Inflation Seminar (Baños El Corazón, November 1994) for useful comments. Very efficient research assistance by Douglas Smith is gratefully acknowledged.

1. INTRODUCTION

"Chile is often presented as the model for the programs of economic restructuring, market liberalization and stabilization that are being urged on other countries within Latin America and in Eastern Europe" (Bosworth, Labán and Dornbusch, 1994, p. 1).

This paper derives and quantifies impact and long-term effects of fiscal and monetary policies in a developing open economy in a framework of a dynamic forward-looking general-equilibrium model. The paradigmatic role attributed to the Chilean experience by many policy makers and economists, reflected by the quotation, justifies choosing Chile for illustrating the consequences of aggregate demand policies in such a framework.¹

Chile has pursued a program of drastic stabilization and deep structural reforms since the mid 1970s. Though fiscal stability was achieved early on, sustained single-digit inflation has eluded Chile to date. The 1978-81 boom was fueled by massive capital inflows, a private-sector spending frenzy, an exchange-rate based stabilization, and high real wage growth as a result of backward-looking nominal wage indexation. The ensuing bust was triggered by adverse terms-of-trade and foreign interest rate shocks topped by the 1982 debt crisis. The deep 1982-83 recession led to massive loan defaults and bankruptcies, forcing the central bank to intervene in financial institutions to avoid a generalized financial crisis, giving rise to huge quasi-fiscal deficits during 1982-85. During the same period the role of the exchange rate as nominal anchor was abandoned and nominal wages were de-indexed, allowing for a massive real exchange rate devaluation and real wage squeeze. The elimination of quasi-fiscal deficits and a conservative fiscal stance since 1987 was combined with an active exchange rate policy geared toward maintaining competitiveness of the traded-goods producing sectors, based on a crawling peg within bands of increasing width. Foreign debt was reduced massively by market-based buy-backs and debt-equity swaps. The conservative macroeconomic framework was continued by the democratically elected government which succeeded the military regime in 1990.

Structural adjustment was accomplished to a large degree already during the 1970s, combining deregulation of domestic goods, labor and financial markets with deep external trade reform, and subsequent external financial liberalization. Chile's most innovative structural reform was the gradual substitution of a privately-managed, fully-funded pension system for a state pay-as-you-go scheme, starting in 1981. At the same time, Chile's major policy mistake was implementing financial liberalization without putting in place adequate financial regulation and supervision -- an error that contributed significantly to overborrowing in the early 1980s and the subsequent financial crisis. After correcting the latter mistake and re-privatizing intervened banks, privatization was taken a further step during the 1980s by extending it to part of health care, public utilities, and infrastructure.

National and foreign saving reacted slowly but steadily to fiscal adjustment, debt reduction, privatization, and pension reform. In the late 1980s Chile -- leading the group of highly indebted countries -- regained access to voluntary foreign lending flows and foreign investment. Domestic investment, spurred by low wages, macroeconomic stability, and a market-friendly environment, reached historically unprecedented levels in the 1990s. GDP growth has been high since 1986, based initially on

¹ For detailed accounts of Chile's macroeconomic policies and outcomes during the last 20 years see the books by Edwards and Cox-Edwards (1987), Morandé and Schmidt-Hebbel (1987), and Bosworth, Labán and Dornbusch (1994) as well as the references cited therein.

a recovery of capacity -- full employment was reached in 1992 after 20 years of abnormally high unemployment -- and subsequently on high investment levels and efficiency gains.

Among Chile's policy issues of continuing relevance, this paper addresses two macroeconomic questions. The first concerns the possible contribution of additional fiscal adjustment to macroeconomic equilibrium in general and a more competitive exchange rate in particular. Due to the real exchange rate appreciation observed in recent years -- resulting from higher domestic spending and massive capital inflows -- it has been argued and counter-argued (see Arrau, Quiroz, and Chumacero, 1992, for a review) that further fiscal adjustment could offset part of the ongoing appreciation. To shed more light on this issue, we analyze here the effects of permanent and temporary, anticipated and unanticipated reductions in public consumption matched by lower general taxation.²

The second policy issue addressed in this paper is about the macroeconomic effects of reducing inflation from double to single-digit levels. Achieving this policy objective -- favored by both policy makers (as espoused by the Chilean President in his May 1994 address to Congress) and economists (for instance Corbo and Fischer, 1994) -- is not trivial in an economy as heavily indexed as Chile. We focus here on an orthodox anti-inflation policy based exclusively on contractionary monetary policy, analyzing the effects of permanent and temporary, anticipated and unanticipated reductions in monetary growth rates.

This paper makes use of a macroeconomic general-equilibrium model fully parameterized for the Chilean economy. The model is firmly based on microanalytic foundations, introducing critical real-world features -- such as short-run wage rigidities and liquidity constraints -- that generate deviations from the frictionless full-employment equilibrium of the unconstrained neoclassical paradigm. Rational expectations are assumed explicitly, so that short-term equilibria depend on current and anticipated future paths of policy and external variables. The simulations show impact, transition, and steady-state effects of policy shifts. The model is an application to Chile of previous work on external shocks, fiscal policy, and monetary policy in representative open economies (Schmidt-Hebbel and Servén, 1994a,b, 1995). To our knowledge this is the first attempt at constructing and using a dynamic macroeconomic model for a developing country consistent with optimizing behavior embedding rational expectations, as well as desirable short-term and stationary equilibrium properties. A second paper explores Chile's macroeconomic response to structural and external shocks (Schmidt-Hebbel and Servén, 1994c).

Section 2 spells out the model structure and discusses the model's dynamics and steady state. The model distinguishes among three agents: the domestic private sector, the consolidated public sector, and the external sector. The private sector (households and firms) consists of one group of intertemporally-optimizing agents and another of liquidity-constrained (or myopic) agents. The domestic economy produces a single good, while the rest of the world produces both an intermediate input and a final good; the three goods are imperfect substitutes. The one-sector assumption on the supply side implies that the model does not distinguish between the real exchange rate and the terms of trade, and that the latter are affected by domestic policies. Resource allocation effects -- say between traded and non-traded goods-

² Thus, the focus is on balanced-budget fiscal retrenchment. However, the term "fiscal adjustment" is often used to refer instead to a change in the public deficit, that still leaves a fiscal gap (positive or negative) to be financed via debt or money printing. But in an intertemporal framework such as ours, permanent debt-financed deficits are not feasible because they would ultimately violate the government's solvency constraint. Under money financing, by contrast, a nonzero public deficit could persist into the distant future (provided the inflation tax base is sufficiently large), but changes in the deficit would involve both a fiscal and a monetary policy element. In order to separate both, we therefore focus on the balanced-budget fiscal retrenchment.

producing sectors -- are also ruled out by our highly aggregated production structure. The asset menu distinguishes among foreign assets (net of foreign debt), domestic government bonds, domestic equity, and domestic money. Asset markets, as well as the domestic goods market, clear instantly and are driven by forward-looking behavior under perfect foresight. In contrast, the labor market can display real and/or nominal wage inertia, giving rise to persistent (but temporary) deviations from full employment.

The dynamics of the model are characterized by the combination of backward-looking dynamic equations describing the time paths of predetermined variables (asset stocks and the real wage) and forward-looking equations describing the trajectory of asset prices. The model displays hysteresis and thus its steady state is path-dependent: it is affected by the initial conditions and the entire adjustment path followed by the economy in response to a shock. Transitory disturbances can therefore have permanent effects, whose magnitude depends on key parameters determining the speed of adjustment of the system. The numerical solution of the model poses a two-point boundary-value problem.

Section 3 presents simulation results for the two sets of contractionary domestic policies and discusses their relevance to the Chilean experience. Section 4 concludes.

2. THE MODEL

The economy produces one single final good, which can be used for consumption and investment at home, or sold abroad. This good is an imperfect substitute for the foreign final good, and its production requires the use of an imported intermediate input.

Domestic private agents hold four assets: money, domestic debt issued by the consolidated public sector (i.e., the government plus the central bank), foreign assets, and equity claims on the domestic capital stock. The public sector also holds foreign assets.³ Money allows for inflationary finance of budget deficits. There are no restrictions to capital mobility and in the absence of risk and uncertainty, all non-monetary assets are assumed to be perfect substitutes. Hence anticipated asset returns satisfy the corresponding uncovered parity conditions. Foreigners hold domestic equity but not domestic public debt.

Both goods and asset markets clear continuously. In contrast, the labor market does not clear instantaneously due to real and/or nominal wage rigidity. Wages are indexed to current and past consumer price inflation, and react slowly to deviations from full employment. Although in a simultaneous model such as ours no specific equation determines any particular variable, equality between demand and supply for the domestic good can be viewed as determining the real exchange rate. Given the latter, and with a flexible nominal exchange rate regime, money market equilibrium with an exogenously set money supply then determines the nominal exchange rate.

The dynamics of the model arise from two basic sources: the accumulation of assets and liabilities, dictated by stock-flow consistency of the sectoral budget constraints, and the forward-looking behavior of private agents. Expectations are formed rationally, which in this context of certainty amounts

³ Foreign assets held by the domestic private and public sectors are net assets (equal to gross foreign reserves plus other gross foreign assets less gross foreign liabilities) and therefore can have either sign.

to perfect foresight. Thus, anticipated and realized values of the variables can only differ at the time of unexpected shocks or due to the arrival of new information about the future paths of exogenous variables.

Behavioral rules combine explicitly two benchmark specifications: neoclassical unconstrained, intertemporally-optimizing firms and consumers, and Keynesian liquidity-constrained firms and households, along with wage inflexibility.⁴ Following the standard theory of investment under convex adjustment costs (Lucas, 1967, Treadway, 1969), unconstrained firms maximize their market value and link their investment decisions to Tobin's q (Tobin, 1969), i.e., the present value of the additional profits associated with the marginal unit of capital relative to its installation cost (Hayashi, 1982). Unconstrained consumers gear consumption to their permanent income, as derived from intertemporal utility maximization in Ramsey fashion (Ramsey, 1928). In contrast, constrained firms (consumers) gear their investment (consumption) expenditure to their current profits (disposable income).

Technology and preferences are kept as simple as possible -- mostly by assuming unit elasticities of substitution. Two-stage budgeting in consumption and investment allows separation between the determination of expenditure and its allocation to domestic and foreign goods (thus avoiding the use of ad-hoc import functions). Harrod-neutral technical progress ensures the existence of steady-state growth, at a level given by the sum of the rates of technical progress and population growth.

The model's detailed structure is introduced next, starting with sector flow budget constraints and market equilibrium conditions. Behavioral equations for firms, consumers, the public sector, and the external sector follow. Variable notation and definitions are summarized in Table 1. All stock and flow variables other than prices and interest rates are scaled to the labor force in efficiency units.⁵ The model is written in continuous time. Dots over variables denote right-hand time derivatives.

2.1 Budget Constraints

There are three basic agents in the model: the consolidated public sector, the domestic private sector, and the external sector. The first includes the non-financial and financial (central bank) public sectors, the second aggregates private firms and consumers, and the third adds foreign investors, creditors, and trade partners. While some further disaggregation between firms and consumers is implicit below, we do not need it at this stage. The budget constraints for each of the three type of agents are written equating above-the-line current account surpluses with below-the-line increases in net real asset holdings per effective labor force unit. Therefore above-the-line interest flows are adjusted for the changes in real asset holdings per effective labor unit due to growth in effective labor (g) and inflation.

Public revenue includes conventional taxes, unrequited foreign transfers, growth-adjusted interest earnings from public assets held abroad, and the return on base money. The latter equals the sum of the inflation tax and the monetary revenue due to the growth of efficiency labor units. Public expenditure includes public consumption, which is assumed to fall entirely on domestic goods, an investment subsidy

⁴ Export demand and wage setting are the only behavioral equations in the model that do not follow (explicitly or implicitly) from first principles.

⁵ Labor force in efficiency units is the actual labor force augmented by Harrod-neutral technical progress (see table 1).

TABLE 1: NOTATION AND DEFINITION OF VARIABLES

1. Labor and Employment

L	Absolute employment
$LF = LF_0 \exp(pg \ t)$	Absolute labor force
LF_0	Base-period absolute labor force
$N = L \exp(tg \ t)$	Absolute employment in efficiency units
$NF = LF \exp(tg \ t) = LF_0 \exp(g \ t)$	Absolute labor force in efficiency units
pg	Population growth rate
tg	Harrod-neutral technical progress rate
$g = pg + tg$	Growth rate of absolute labor force in efficiency units
t	Time index
$l = L/LF = N/NF$	Employment (relative to labor force)
ld	Labor demand (relative to labor force)

2. General Notation

All stock and flow variables other than interest rates are defined in real terms. Current-price domestic (external) income and transfer flows and prices are deflated by the price of the domestic good (external price deflator). All stock and flow variables other than prices and interest rates are defined in terms of units of effective labor force. Domestic (external) relative prices are measured in real domestic (external) currency units. A dot over a variable denotes its right-hand time derivative.

3. Income, Transfer and Capital Flows

Domestic:

d	Dividends paid
op	Operational profits
td	Taxes
yd	Private disposable income
$prem$	Profit remittances abroad

External:

$ftrg$	Foreign transfers to the public sector
$ftrp$	Foreign transfers to the private sector
yf	Foreign income
$dfti$	Direct foreign investment

4. Stocks

Domestic:

a	Non-human wealth of the private sector
hg	Domestic debt of the public sector
fe	Stock of domestic equity (shares in domestic firms) held by foreigners
hb	Domestic base money
hu	Human wealth of the private sector
k	Physical capital
$pvig$	Present value of government investment subsidy
$pvihb$	Present value of cost of holding money

External:

fbg	Foreign assets held by the public sector
fbp	Foreign assets held by the private sector

TABLE 1 (Cont.)

5. Goods Flows

y	Gross output of final goods
cp	Private aggregate consumption
c _{mp}	Private imported-goods consumption
c _{np}	Private national-goods consumption
c _{ng}	Public national-goods consumption
inv	Gross domestic investment
i _n	Private national-goods investment
i _m	Private imported-goods investment
ig	Public investment subsidy
iac	Investment adjustment costs
x	Exports
mr	Intermediate imports

6. Various Rates

Domestic (External) Rates:

i (if)	Nominal interest rate on public debt (foreign assets/liabilities)
r (rf)	Real interest rate on public debt (foreign assets/liabilities)
i-r (if-rf)	Anticipated domestic (external) inflation rate
nmg	Rate of growth of the nominal money stock

7. Goods Prices

Domestic (all relative to the price of the domestic final good):

pc	Private aggregate consumption deflator
pi	Aggregate investment deflator

External (all relative to the price of the foreign final good):

p _{cmp}	Private imported-goods consumption deflator
p _{im}	Imported-goods investment deflator
p _{mr}	Intermediate imports deflator
p _x	Deflator of export-competing goods

8. Other Prices

Domestic Prices:

q	Real equity price (Tobin's q) in units of domestic output
v	Real wage per effective labor unit
W	Nominal wage per labor unit
PC	Nominal private consumption deflator

Real Exchange Rate:

$e = (E P^*)/P$	Real exchange rate
E	Nominal exchange rate
P	Nominal price of the domestic good
P*	Nominal external deflator (foreign price level)

paid to domestic firms,⁶ and interest paid on the outstanding stock of domestic public debt. Revenues include direct taxes, interest on net foreign assets of the public sector, and the inflation tax. The resulting adjusted operational surplus of the consolidated public sector finances acquisition of foreign assets and retirement of base money and domestic debt:

(1)

$$[td + e \text{ frg} - \text{cng} - \text{pi ig}] - (r-g) \text{bg} + (g+\dot{P}/P) \text{hb} + e(\text{rf} - g) \text{fbg} = e \dot{\text{fbg}} - \dot{\text{bg}} - \dot{\text{hb}}$$

The external sector budget constraint -- the balance of payments identity -- reflects trade in goods and non-factor services, unrequited transfer payments to both the public and private sectors, loans from both domestic sectors, and foreign investment flows toward the private sector as well as profit remittances from the latter. Therefore, the adjusted external current account surplus and its financing, for convenience written in constant-price foreign currency units, is the following:

(2)

$$\left[\frac{x}{e} - \text{pcmp cmp} - \text{pim im} - \text{pmr mr} + \text{frg} + \text{ftrp} \right] + (\text{rf} - g) [\text{fbp} + \text{fbg}] - \frac{\text{prem}}{e} \\ = (\dot{\text{fbp}} + \dot{\text{fbg}}) - \dot{\text{dfi}}$$

The private sector budget constraint reflects the assumption that private firms do all production and make all investment decisions, own the economy's entire capital stock, and benefit from a public investment subsidy. Firm ownership is split between domestic consumers and foreigners. The consolidated domestic private sector (firms and consumers) budget constraint is given by:

(3)

$$[y - \text{pi inv} - \text{pi iac} - e \text{pmr mr} + e \text{ftrp} - \text{td} + \text{pi ig} - \text{pc cp}] - (g+\dot{P}/P) \text{hb} \\ + (r-g) \text{bg} - \text{prem} + (\text{rf}-g) e \text{fbp} = \dot{\text{hb}} + \dot{\text{bg}} - e \dot{\text{dfi}} + e \dot{\text{fbp}}$$

2.2 Market Equilibrium Conditions

Equilibrium conditions are specified for goods, asset, and labor markets. Continuous market clearing at equilibrium goods prices and asset returns contrasts with sluggish wage adjustment observed in the labor market.

⁶ Public sector ownership of the capital stock could be mimicked by introducing a tax on profits proportional to the cumulative volume of public investment. For simplicity, we do not pursue this option here. Also, we are implicitly assuming that public investment is a perfect substitute for private investment.

Goods Markets

The single good produced domestically can be used for consumption and investment at home, or sold abroad (thus there is no distinction between production for domestic and export markets). It is an imperfect substitute for the foreign final good. However, the economy is small in its import markets by assumption. Equilibrium in the market for domestic goods can be expressed:⁷

$$(4) \quad y = cnp + cng + in + pi iac + x$$

Under continuous market clearing, this can be interpreted as an implicit equation for the real exchange rate.

Asset Markets

Asset market equilibrium conditions are specified for base money, domestic bonds, and equity claims on the fixed capital stock. They reflect three features: perfect capital mobility, external interest rate determination in international markets (the small country assumption for financial markets), and absence of uncertainty (no risk premia). Imperfect substitutability between base money and other assets is reflected by a conventional transactions-based demand for base money. Domestic and foreign bonds, as well as equity, are assumed perfect substitutes; hence their anticipated rates of return must be equalized at each point in time.

Base money market equilibrium assumes standard Cagan-type money demand (Cagan, 1956):⁸

$$(5) \quad hb = \phi_1 y^{\phi_2} \exp(\phi_3 i)$$

where $\phi_1, \phi_2 \geq 0, \phi_3 \leq 0$.

Arbitrage between domestic and foreign bonds leads to the uncovered interest parity condition:

$$(6) \quad r = rf + \frac{\dot{e}}{e}$$

Similarly, arbitrage between equity and domestic public bonds is reflected by the following market equilibrium condition for equity prices (Tobin's q):

⁷ Note that gross output y differs from conventional national-accounts value added or GDP for two reasons: y is defined as gross of the value of intermediate imports ($e pmr mr$) and gross of the value of investment adjustment costs ($pi iac$).

⁸ One way to rationalize (5) would be to assume that individuals' utility function is additively separable in consumption and the transaction services of money, with the latter increasing with real money and decreasing with the overall volume of transactions as measured by real output. This kind of formulation rules out distortionary effects of inflationary taxation, which in our framework is a convenient feature given that taxes are likewise assumed non-distortionary.

$$(7) \quad \dot{q} = r q - \frac{d}{k}$$

Finally, the nominal interest rate is defined by the standard Fisher equation:

$$(8) \quad i = r + \frac{\dot{P}}{P}$$

Labor Market

In the general case, wage rigidity (nominal and/or real) prevents the labor market from clearing instantaneously. We follow the conventional assumption that employment is determined by labor demand:

$$(9) \quad 1 = l_d$$

The labor market follows a wage-setting rule, which states that nominal wages are indexed to current and lagged consumer price inflation (with weights Θ and $1-\Theta$, respectively) and also respond to current labor market conditions (with an elasticity ω with regard to employment). Anticipating the simulations, the nominal wage equation is written in discrete-time form:⁹

$$(10) \quad W = \exp(\theta g) l^\omega \left(\frac{PC}{PC_{-1}} \right)^\theta \left(\frac{PC_{-1}}{PC_{-2}} \right)^{1-\theta} W_{-1}$$

where $\omega \geq 0$, $0 \leq \Theta \leq 1$.

2.3 Firms

Technology is summarized by a Cobb-Douglas production function for gross output with Harrod-neutral technical progress and quadratic adjustment costs for investment. The investment technology combines domestic and imported final goods according to a Cobb-Douglas specification, which allows for two-stage budgeting.¹⁰

There are two groups of firms. The first group is not subject to liquidity constraints and determines its investment according to the maximization of market value -- i.e., the present value of future dividends -- subject to convex adjustment costs. Investment is financed by equity sold to domestic and foreign agents and through the public investment subsidy, which takes the form of a lump-sum transfer of capital goods to private firms. However, as long as the subsidy is infra-marginal, it has no effect whatsoever on investment levels of unconstrained firms.

⁹ Using the relation between the nominal wage and the real (product) wage per effective labor unit: $W/P = \exp(\theta g) v$, we obtain, after some manipulations, the following real wage equation: $v = l^\omega [pc/pc_{-1}]^\theta [pc_{-1}/pc_{-2}]^{1-\theta} [(P_{-1}/P_{-2})/(P/P_{-1})]^{1-\theta} v_{-1}$. This wage rule encompasses several interesting cases. First, when ω tends to infinity, it collapses into the neoclassical full-employment condition ($l = 1$). Second, for finite ω and $\theta = 1$, it represents the case of real wage resistance. In turn, with finite ω and $\theta < 1$, wages display nominal inertia.

¹⁰ Wildasin (1984) provides exact conditions under which the investment technology gives rise to a two-stage investment decision. See also Hayashi and Inoue (1991) for a recent generalization with empirical applications.

The second group of firms is restricted in its access to financial markets and gears its current investment to current profits inclusive of the public investment subsidy. Thus, for these constrained firms changes in the subsidy will affect fixed investment levels.

The production technology for gross output is described by a Cobb-Douglas production function, which allows for substitution between value added (capital and labor) and intermediate imports:

$$(11) \quad y = \alpha_0 l^{\alpha_1} k^{\alpha_2} m^{(1-\alpha_1-\alpha_2)}$$

where $\alpha_0 \geq 0$, $0 \leq \alpha_1, \alpha_2 \leq 1$.

Investment adjustment costs are defined by:

$$(12) \quad iac = \mu \left[\frac{(\text{inv} - (g+\delta)k)^2}{k} \right]$$

where $\mu > 0$. Adjustment costs vanish in steady-state equilibrium -- i.e., when gross investment per unit of effective labor is just sufficient to maintain the capital/effective labor ratio. The evolution of the latter is described by:

$$(13) \quad \dot{k} = \text{inv} - (g+\delta)k$$

Market value maximization for unconstrained firms, as well as current profit maximization for constrained firms, yields the standard marginal productivity conditions for variable inputs (labor and imported materials):¹¹

$$(14) \quad l = \alpha_1^{-1} y$$

$$(15) \quad m = (1 - \alpha_1 - \alpha_2) (e \text{ pmr})^{-1} y$$

Investment demand is, as described above, a combination of the market-value maximizing investment rule of unconstrained firms and the profit-constrained investment of restricted firms:¹²

$$(16) \quad \text{inv} = \beta_1 \left[\frac{k}{2\mu} \left[\frac{q}{pi} - \frac{pvig}{pi k} - 1 \right] + (g+\delta)k \right] + (1-\beta_1) \left[\beta_2 \frac{op}{pi} + ig \right]$$

¹¹ The derivation of these conditions, as well as of the unconstrained component of investment in equation (16) below, follows the standard maximization of the value of the firm, subject to equations (11) - (13), not presented here for brevity.

¹² Unconstrained investment (the content of the first large right-hand side parenthesis) is geared to Tobin's marginal q , i.e., average q minus the present value of the public investment subsidy per unit of capital (see Hayashi (1982) for general reasons causing marginal and average q to diverge). This reflects the fact that optimal investment is determined by the addition to future dividends of the marginal unit of capital, which excludes the subsidy due to its lump-sum nature. In contrast, the average value of existing capital, i.e., the present value of the dividends associated with an installed unit of capital, must include the subsidy. Investment by constrained firms (the last term on the right side of (16)) rises one-for-one with the investment subsidy.

where β_1 is the share of non-constrained firms and β_2 is the marginal propensity of liquidity-constrained firms to invest out of operational profits; $0 \leq \beta_1, \beta_2 \leq 1$.

The present value of the public investment subsidy is implicitly defined by the dynamic equation:

$$(17) \quad p\dot{v}ig = (r-g) p\dot{v}ig - p_i ig$$

Aggregate operational profits, which determine investment by liquidity-constrained firms, are:

$$(18) \quad op = y - v l - e pmr mr$$

and dividends are the sum of operational profits, net of investment expenditure, the investment subsidy, and the proceeds of new issues of equity:

$$(19) \quad d = op - p_i inv - p_i iac + p_i ig + q(k + gk)$$

After determining aggregate investment according to equation (16), the second-stage investment decision involves allocating investment expenditure between domestic goods and imports, according to a Cobb-Douglas aggregation which renders constant expenditure shares:

$$(20) \quad in = \gamma p_i inv$$

$$(21) \quad im = (1 - \gamma) \left[\frac{p_i}{e pim} \right] inv$$

where γ is the share of national-goods investment in aggregate investment expenditure, satisfying $0 \leq \gamma \leq 1$. Therefore the aggregate investment deflator is a Cobb-Douglas average of national-goods investment prices and imported investment-goods prices:

$$(22) \quad p_i = (e pim)^{(1-\gamma)}$$

2.4 Consumers

Consumer preferences also allow two-stage budgeting, distinguishing between intertemporal aggregate consumption decisions and intratemporal consumption composition choices. Intertemporal preferences reflect unit intertemporal elasticity of substitution (i.e., logarithmic intertemporal utility); intratemporal preferences also display unit elasticity of substitution between domestic and imported goods.

Private sector non-human wealth includes four assets: base money, domestic public bonds, foreign assets, and equity claims on the domestic capital stock. Forward-looking consumers fully discount from their wealth the costs of holding money balances:

$$(23) \quad a = hb + bg + e fbp + q(k-fe) - p\dot{v}ihb$$

where the present value of money holding costs $p\dot{v}ihb$ is just the discounted sum of interest payments foregone on money balances, and is implicitly defined by the dynamic equation:

$$(24) \quad p\dot{v}ihb = (r-g) p\dot{v}ihb - i hb$$

Human wealth is the present value of future labor income, net of taxes, and inclusive of current external transfers.¹³ Under the assumption that individuals can freely borrow against their future labor income at the going real interest rate, the path of human wealth is characterized by:

$$(25) \quad \dot{h}u = (r - g) hu + [td - v1 - e ftrp]$$

Consumption of non-liquidity constrained consumers is derived from standard maximization of intertemporal utility over an infinite horizon, subject to the intertemporal budget constraint equivalent of the private sector flow constraint in equation (3) -- which is exactly consistent with wealth definitions in equations (23) - (25).¹⁴ Unconstrained consumers are of course Ricardian, internalizing the government's intertemporal budget constraint by anticipating the entire stream of current and future tax payments. Because these consumers face the same discount rate as the government,¹⁵ and inflation taxation is non-distortionary, they are indifferent among tax, debt, or money financing. Thus government debt, although included in equation (23), ultimately "is not wealth" (Barro, 1974).

Total private consumption demand is an aggregate of consumption by unconstrained and constrained consumers. The latter hold no assets and consume their current net labor income:¹⁶

$$(26) \quad cp = (\lambda_2 - g) \frac{a}{pc} + \lambda_1 (\lambda_2 - g) \frac{hu}{pc} + (1 - \lambda_1) \frac{yd}{pc}$$

where $0 \leq \lambda_1 \leq 1$ is the share of unconstrained consumers, and λ_2 is the subjective discount rate. Thus, if all consumers are unconstrained, consumption depends only on the sum of human and financial wealth, and disposable income plays no role.

Disposable income is defined by:

$$(27) \quad yd = v1 + e ftrp - td$$

After determining aggregate private consumption levels according to equation (26), the second-stage private consumption decision allocates it between domestic goods and imports, according to Cobb-Douglas intratemporal preferences:

$$(28) \quad cnp = \eta pc cp$$

¹³ For expositional convenience, all taxes and transfers have been lumped together in the human capital flow equation. Since both accrue in lump-sum fashion, this is of no consequence for the model's properties.

¹⁴ As before, the analytical derivations are standard and can be omitted. Solving the maximization problem yields the standard result that private consumption of unconstrained households is equal to the subjective discount rate (net of effective labor growth) times total (human and non-human) wealth.

¹⁵ The assumption of equal discount rates is crucial for Ricardian equivalence to hold. Higher private sector discount rates, whether due to finite lifetimes (reflected by a given probability of death, as in Blanchard, 1985) or to a risk premium on consumers' debt relative to the borrowing cost of the government (e.g., McKibbin and Sachs, 1989) would cause Ricardian equivalence to break down.

¹⁶ For discussion and empirical analyses of the implications of liquidity constraints for consumer behavior -- as well as for Ricardian equivalence -- see, for example, Hayashi (1985), Hubbard and Judd (1986), Bernheim (1987), Leiderman and Blejer (1988), and Seater (1993).

$$(29) \quad \text{cmp} = (1 - \eta) \left[\frac{\text{pc}}{e \text{ pcmp}} \right] \text{cp}$$

where $0 \leq \eta \leq 1$ is the share of national-goods in aggregate private consumption expenditure. Therefore the aggregate private consumption deflator is a Cobb-Douglas index of national-goods prices and imported consumption goods prices:

$$(30) \quad \text{pc} = (e \text{ pcmp})^{(1-\eta)}$$

2.5 Government

The public sector determines policy exogenously, thus public consumption and investment expenditures are given. To finance its activity, the public sector can choose among taxes, money, domestic debt, or external borrowing (or any combination of them).

The accumulation of per capita real balances can be characterized as:

$$(31) \quad \dot{\text{hb}} = [\text{nmg} - (\dot{\text{P}}/\text{P}) - g] \text{hb}$$

where it is worth noting that the rate of nominal money growth nmg will be endogenous under money finance of the deficit and exogenous otherwise.

2.6 Foreigners

The demand by foreigners for the domestically produced good is given by a conventional export function, which displays inertia and embodies imperfect substitution between the national and the foreign final good and a normal relation to foreign income:

$$(32) \quad x = \rho_1 (e \text{ px})^{\rho_2} y^{\rho_3} x_{-1}^{\rho_4}$$

where $\rho_1, \rho_2, \rho_3, \rho_4 \geq 0$.

Foreigners can also hold domestic equity. Rather than going into the details of their portfolio allocation problem, we assume that at every instant foreign investors use dfi units of foreign currency (in real per capita terms) to purchase domestic shares, whose price in terms of domestic output is q . Hence foreign investors' per-capita holdings of equity evolve according to the equation:

$$(33) \quad \dot{\text{fe}} = \frac{e \text{ dfi}}{q} - g \text{ fe}$$

In turn, profit repatriation equals the total volume of dividends earned by foreign investors, which is given by the product of the share of foreign-held equity and total dividends:

$$(34) \quad \text{prem} = \frac{\text{fe}}{k} d$$

2.7 The Steady State, Dynamics, and Model Solution

The long-run equilibrium of the model is characterized by constant output in per capita terms (so that long-run growth equals the growth rate of the effective labor force), constant asset stocks in real per capita terms, constant asset prices (i.e., Tobin's q and the real exchange rate), and constant real wages with full employment. Thus, the government's budget (inclusive of seigniorage revenue) must be balanced, and the current account deficit must equal the exogenously given flow of foreign investment, which in turn is just sufficient to keep foreign equity holdings (in real per capita terms) unchanged.

Since the per capita real money stock is constant, long run inflation equals the rate of expansion of per capita nominal balances $nmg - g$. In turn, with a constant real exchange rate, domestic and foreign real interest rates are equalized by uncovered interest parity, and nominal exchange depreciation is determined by the difference between domestic and foreign inflation. Hence, across steady states changes in the rate of money growth are fully reflected in the inflation rate (and thus in the nominal interest rate) and in the rate of nominal depreciation.

By combining the model's equations, the steady-state equilibrium can be reduced to two independent equations in the real exchange rate, real wealth, and the real interest rate: a goods market equilibrium condition and a zero private wealth accumulation condition (in real per capita terms). They jointly imply a constant stock of per capita net foreign assets. Goods market equilibrium defines an inverse long-run relationship between real wealth and the real exchange rate: higher wealth raises private consumption demand and requires a real exchange rate appreciation to clear the domestic goods market.

In turn, real wealth accumulation can cease only when per capita consumption equals the per capita return on wealth. This poses the well-known requirement that, for a steady state to exist, the rate of time preference must equal the exogenously given world interest rate.¹⁷ But then the zero-wealth accumulation condition provides no information whatsoever on the steady-state level of wealth: with the return on wealth being entirely consumed, any wealth stock is self-replicating. We are thus left only with the goods market equilibrium condition to determine both long-run wealth and the real exchange rate -- an obviously impossible task.

This means that the steady-state wealth stock must be found from the economy's initial conditions and from its history of wealth accumulation or de-accumulation along the adjustment path. Hence the steady-state values of wealth and the real exchange rate (and therefore all other variables related to them) depend not only on the long-run values of the exogenous variables, but also on the particular trajectory followed by the economy. In other words, the model exhibits hysteresis. As noted by Giavazzi and Wyplosz (1984), this follows from the assumption of forward-looking consumption behavior derived from intertemporal optimization by infinitely-lived households with a constant rate of time preference and facing perfect capital markets.

Nevertheless, certain important features of the steady state can easily be determined.¹⁸ Long-run equilibrium is characterized by full employment and a constant capital stock in per capita terms. From (13), gross investment is just $inv = (g + \delta)k$, and adjustment costs are identically zero (from (12)). In turn, from (7), (17), (18) and (19), Tobin's q in steady state is given by:

¹⁷ Recall that, because of perfect asset substitutability, the per capita real return on wealth is just equal to the real interest rate (net of effective labor force growth) times the wealth stock. In turn, steady-state consumption equals the rate of time preference (also net of effective labor force growth) times the wealth stock.

¹⁸ Giavazzi and Wyplosz (1985) provide a method to solve analytically certain linear models with hysteresis. They show that the long-run equilibrium depends on initial conditions and on the speed of adjustment of the system. Since our model is nonlinear, however, a comparable solution technique is not available.

$$(35) \quad q = \frac{F_k - \pi (g + \delta)}{(rf - g)} + \pi v_{ig}/k$$

where F_k is the marginal productivity of capital.¹⁹

It is important to note that with some firms liquidity constrained (i.e., $\beta_1 < 1$), in the steady state q does not equal the subsidy-inclusive price of capital goods, nor does F_k equal the user cost of capital. Intuitively, with binding liquidity constraints firms cannot invest as much as they would want and therefore cannot close the gap between the shadow value of one additional unit of capital and its cost. Thus, provided the marginal propensity to invest of constrained firms (β_2 in (16)) is not too large,²⁰ F_k must exceed the user cost, and q must exceed the price of capital goods plus the investment subsidy:

$$(36) \quad F_k = \pi [(rf + \delta) + f]$$

where $f > 0$ is a term that depends positively on the adjustment cost coefficient μ and the rate of depreciation of capital, and negatively on β_1 , β_2 , and the investment subsidy.²¹ Tobin's q becomes:

$$(37) \quad q = \frac{\pi [(rf + \delta) + f]}{(rf + \delta)} + \pi v_{ig}/k$$

It is important to note that, regardless of whether firms are liquidity-constrained or not, the steady-state displays a negative association between the real exchange rate and the capital stock. This can be seen from (36): given a capital stock, F_k is a decreasing function of the real exchange rate because of imported materials in production, while π is an increasing function of the real exchange rate due to the import content of capital. Hence, across steady states, a real depreciation unambiguously reduces the capital stock, and (from (11) and (14)) output and the real wage. The long-run values of all these variables depend on initial conditions and on the economy's adjustment path.²² In turn, (36) and (37) further imply that, for any given long-run real exchange rate, the economy's capital stock, output and real wage will be lower under liquidity constraints than in the fully unconstrained case.

An important implication of the model's hysteresis property is that even transitory disturbances have long-run effects. For the case of fiscal policy, this has been recently highlighted by Turnovsky and Sen (1991).²³ In our model even transitory monetary disturbances can have permanent real effects: with some consumers liquidity constrained (or myopic), a transitory increase in inflationary taxation matched

¹⁹ If no firms are liquidity constrained (i.e., $\beta_1 = 1$ in (16)), then (16) further guarantees that marginal q equals the price of capital goods or, equivalently, that average q equals the price of capital plus the unit investment subsidy (i.e., $q = \pi + \pi v_{ig}/k$). Thus, from the above equation the marginal product of capital equals its user cost: $F_k = \pi (rf + \delta)$.

²⁰ The exact condition is $\beta_2 < (g + \delta)/(rf + \delta) - ig/(\alpha_2 y)$.

²¹ The exact expression for f is $f = \{[\beta_1(rf + \delta) + (1 - \beta_1) 2\mu (rf - g)(g + \delta)] / [\beta_1 + (1 - \beta_1) 2\mu (rf - g)(\beta_2 + z/\alpha_2)]\} - (rf - \delta)$, where $z = ig/y$ is the public investment/gross output ratio.

²² This is in contrast to similar dynamic models (e.g., Sachs (1983), Giavazzi et al. (1982)), where capital goods have no import content, thus the steady-state marginal product of capital (and the capital stock and real output) depends only on the relative price of materials in terms of domestic goods (e pmr here). Here the import content of capital goods creates a negative relationship between the real exchange rate and F_k , even for a given real cost of imported materials. Gavin (1991) and Serven (1991) show that this has important consequences for the effects of macroeconomic policies on investment.

²³ Turnovsky and Sen (1991) use a non-monetary model with intertemporally optimizing consumers to show that transitory fiscal disturbances have long-run effects. Their result depends critically on the endogeneity of labor supply, making long-run employment endogenous. In our case, the dependence of the long-run capital stock on the real exchange rate ensures that transitory fiscal shocks have permanent effects despite constant full-employment across steady states.

by a reduction in direct taxes will raise disposable income and consumption, leading to reduced wealth accumulation and eventually causing a fall in long-run wealth and a permanent real depreciation.²⁴

The precise dynamics of the model depend on how the public deficit is financed. With money or tax finance, the model is driven by ten dynamic equations. Four describe the time paths of pre-determined variables: the capital stock, private foreign assets, foreign equity holdings, and the real wage. At each moment in time, these variables are given by current and past values of endogenous and exogenous variables. Further, these predetermined variables must satisfy well-defined initial conditions. Under debt (domestic or foreign) finance, a fifth dynamic equation describes the time path of the relevant debt stock.

The remaining dynamic equations describe the time paths of 'jumping' variables: Tobin's q , the real exchange rate, real money balances, human wealth, the present value of the investment subsidy, and the present value of the cost of holding money. They are not predetermined and can react freely to 'news' about current and future values of exogenous variables; their equilibrium values at any point in time depend on the entire future anticipated path of the forcing variables. For the complete dynamic system not to explode, these jumping variables have to satisfy certain terminal (transversality) conditions. Solving the model basically amounts to finding initial values for the non-predetermined variables such that, following a shock, the model will converge to a new stationary equilibrium. The necessary and sufficient conditions for the existence and uniqueness of such initial values in linear models of this type have been investigated in the literature,²⁵ though this is not the case for large non-linear models like this one.²⁶ While a formal proof of stability cannot be provided, numerically the model was always found to converge to the new long-run equilibrium under reasonable parameter values.

The requirement that the predetermined variables satisfy initial conditions, while the jumping variables must satisfy terminal conditions, poses a two-point boundary-value problem. One technique used to obtain a numerical solution is the "multiple shooting" method proposed by Lipton et al. (1982). A second solution technique is the "extended path" algorithm of Fair and Taylor (1983). For the simulations below, we combine both techniques. First, we solve the model over an arbitrarily chosen time horizon using multiple shooting. To prevent the solution from being distorted by the choice of too short a time horizon (causing the model to reach the steady state too early), we then extend the horizon and recompute the solution path; we keep doing this until the resulting changes in the solution trajectory of the endogenous variables fall below a certain tolerance,²⁷ at which time the process stops. In practice, the length of the simulation horizon required for this procedure to converge is strongly affected by two parameters governing the speed of adjustment of the system: the elasticity of real wages to employment (i.e., the slope of the Phillips curve), and the magnitude of adjustment costs for investment.

Finally, unlike other simulation methods in the literature, we solve the full non-linear model, rather than a linearized version of it. The reason is that the linear approximation can be quite unreliable when simulating "large" shocks.

²⁴ Without liquidity constraints, a monetary acceleration (an increase in nmg) holding constant public expenditure would just amount to a change in the composition of taxation between the inflation tax and (present or future) direct taxes (or transfers), without any effect on wealth, consumption, or any other real variable.

²⁵ See Blanchard and Kahn (1980) and Buiter (1984).

²⁶ In principle, we could linearize the system around a steady state to determine analytically the conditions whereby the transition matrix possesses the saddle-point property. For a tenth-order system, however, this would be an intractable task.

²⁷ We used a very strict convergence criterion, requiring that the maximum relative change between solutions in any variable at any time period not exceed one-thousandth of one percent. This typically required a horizon of at least fifty periods for convergence.

3. SIMULATION RESULTS

This section briefly summarizes the parameterization of the preceding model to the Chilean economy and discusses at length its dynamic response to two sets of policy simulations: a contractionary fiscal policy and a contractionary monetary policy.²⁸

3.1 Model Parameterization

Parameterization involves a choice of values for the model's behavioral parameters and a calibration of behavioral equations and budget identities to a certain base period. The model's behavioral equations were estimated econometrically using a Chilean historical sample period of annual data covering 1960-1992. These equations and the three budget constraints were calibrated to a recent historical year: 1992. For this year steady-state equilibrium conditions were imposed, i.e., per capita state variables and prices were assumed to be constant.²⁹ Hence the first period of our counter-factual simulations could be interpreted as 1993, if 1992 had been a stationary equilibrium year. In Schmidt-Hebbel and Serven (1994c) we provide a detailed explanation of the parameterization process, reporting data sources, the complete set of econometric estimations, parameter values, calibrated base-year budget identities, base-year steady-state values of exogenous and endogenous variables.

As discussed in section 2.7, the speed of convergence to a new steady state and the particular adjustment path taken by the endogenous variables depend critically on the values of certain key parameters, summarized briefly next. The elasticity of nominal wages with respect to current employment (relative to the labor force) is 1.8 (under instantaneous labor market clearing it would be infinity). Nominal wages are indexed to current and lagged consumer price inflation with weights 49% and 51%, respectively. The quadratic adjustment cost coefficient for investment is 19.57, a large figure that implies a very slow investment response. The share of unconstrained agents -- consumers and firms -- is 55.0% and 29.5%, respectively, well below the 100% share of the unconstrained neoclassical benchmark. The import content of investment (37%) is four times the import content of consumption (9%). Finally, the intertemporal elasticity of substitution in consumption is restricted to one, a value consistent with previous econometric estimations for Chile (Schmidt-Hebbel 1987, Arrau 1989).

3.2 Simulation Features

For the simulations, the adjusting variable for the public sector is total taxes (td) and for the private sector the residual budgetary variable is foreign asset holdings (fbp).³⁰ The simulations explore

²⁸ Schmidt-Hebbel and Serven (1994a) analyze fiscal policy under alternative means of financing in this model calibrated for a prototypical developing economy. Schmidt-Hebbel and Serven (1994c) explore the Chile model's response to permanent/temporary, anticipated/unanticipated structural shocks, including a decline in the foreign real interest rate, an increase in the subjective discount rate, and an increase in the rate of technical progress. Serven (1994) explores analytically the impact of fiscal disturbances in a non-monetary model closely related to ours.

²⁹ This is a common assumption for rational expectation model simulations. It allows us to focus on the impact, transition, and steady-state effects of policy shifts "uncontaminated" by the non-stationary equilibrium of the economy. The slack variables for the two independent budget constraints were chosen to be total taxes and foreign transfers to the government -- hence they reflect base-year changes in per capita state variables and prices.

³⁰ Actual model simulations assume that the private sector intratemporal budget constraint (equation (3)) is the redundant budget constraint by Walras' Law, hence it is excluded from the set of model equations. (Obviously the intertemporal budget constraint is still used in deriving optimal private consumption levels). Hence td and fbp are the endogenous variables associated

three alternatives: a permanent unanticipated (PU) policy shift (hitting the economy from period 1 to terminal period T), a transitory unanticipated (TU) policy change (hitting during periods 1 to 4), and a permanent anticipated (PA) policy change (hitting from period 3 to T). For the fiscal policy simulation, the types of policy shifts are PU and TU, while under the monetary simulation, the policy changes are PU, PA, and TU.

The discussion of the simulation results focuses on the deviations from an initial steady-state equilibrium (represented by period 0), distinguishing between the impact effects (in period 1), the transition toward the new steady-state equilibrium (from periods 2 to T-1), and the final steady state (terminal period T). The discussion will be based on the figures depicting the dynamic paths of the main endogenous variables. Each figure page is divided into an upper and a lower panel, each of which reports the dynamic trajectories of a different endogenous variable. The figures report trajectories of endogenous variables for period 0 (the initial steady state), 1 to 11, T-1, and T.³¹

3.3 Fiscal Contraction: The Contribution to Real Exchange Rate Competitiveness

We start by considering the effects of a public-sector retrenchment as reflected by a balanced-budget fiscal contraction. Fiscal adjustment falls on public consumption, which declines by 2 percentage points (pp) of initial steady-state output, from 7.7% to 5.7%. Lower public spending is matched by a reduction in overall taxation. The tax reduction shifts wealth from the public to the private sector, increasing private consumption. This transfer reduces aggregate expenditure on national goods (public consumption falls only on national goods) and raises aggregate expenditure on imported goods (8% of private consumption falls on imported goods). This expenditure-composition effect is the main direct consequence of the balanced-budget fiscal contraction, other than temporary effects on the behavior of liquidity-constrained agents.

The expenditure switch causes a long-term real exchange rate depreciation, a decline in investment (because imported investment goods are more expensive), lower output, and lower real wages. The impact effects differ from the steady-state effects: on impact there is an aggregate demand reduction, followed by a gradual aggregate supply contraction due to slow disinvestment.

Consider first the PU policy shift occurring in period 1 and thereafter. Lower public consumption raises wealth of borrowing-unconstrained consumers, who internalize the government's budget constraint, and increases disposable income of borrowing-constrained consumers. As a result of the behavior of both groups of consumers, the share of private consumption in output rises immediately by 1.9 pp, close to the steady-state effect on private consumption (Figure 1).

The investment/output ratio falls by 0.05 pp in period 1, since the real depreciation raises the price of imported capital. Its implication for the level of output is a 0.4 pp steady-state decline (Figure 2). At the instant of the shock, output drops by 0.23 pp and then gradually declines further toward its new steady state. The decline is gradual as disinvestment proceeds slowly due to adjustment costs. Note that this decline in gross national output (gross of intermediate imports) is model-specific and reflects the negative relation between output and the relative price of imported to national goods. In a more general

to the public sector budget constraint (1) and the external sector budget constraint (2), respectively.

³¹ The multiple-shooting extended-path simulation program was written in Gauss. The terminal period T varies between 50 and 110 periods.

model with a disaggregated production structure (say between tradable and non-tradable goods-producing sectors), the relation between aggregate output and the real exchange rate is ambiguous.

Reflecting the impact drop in aggregate demand for national goods, the real exchange rate depreciates by 2%, overshooting its new long-term level. Overshooting is due to the fact that starting in period 2 aggregate supply contracts as a result of disinvestment, causing a gradual and slight appreciation toward the new steady state, where the real exchange rate is still 1.33% more depreciated than in the original steady state. What is the effect of a more competitive exchange rate on exports? Given a long-term real-exchange-rate elasticity of export demand of 0.43, exports are raised by 0.58% by the long-term depreciation.

With unchanged monetary growth, the output loss in period 1 reduces money demand, causing inflation to increase temporarily by 0.2% on impact, later converging back to the stationary annual level of 14% (Figure 3).

The real wage reflects the long-term decline in labor demand due to a falling capital stock. In the final steady state, the real wage is 0.22% lower than in the original equilibrium. During the transition, however, backward indexation affects it as well, as wages are indexed to current and lagged inflation. In period 1, higher inflation causes real wages to fall, but not enough to preclude a temporary decline in employment of 0.1 pp (Figure 4).

Recalling that we consider here a balanced-budget fiscal retrenchment ruling out an increase in public saving -- as opposed to a reduction in government consumption reflected by higher public saving and, hence, by a lower first-round current-account deficit -- all temporary current-account effects stem only from the public/private wealth transfer and its induced effects.³² Under these conditions, the current account could deteriorate or improve in the short run, depending on the size of the intertemporal elasticity of substitution in consumption relative to the coefficient of investment adjustment costs.³³ In our case of a unit intertemporal elasticity and high investment adjustment costs, the foreign-currency current account ratio deteriorates by 0.05 pp in period 1; the domestic-currency current account ratio deteriorates by 0.1 pp of output because of the real depreciation.³⁴ This external deficit reflects a de-accumulation of private wealth, leading to lower consumption and output in the long term.

³² As an example of a reduced-form framework that does not consider explicitly the fiscal-financing and general-equilibrium effects of fiscal adjustment consider the results for Chile by Marshall and Schmidt-Hebbel (1994). Their assessment of the consequences of fiscal policy on the external equilibrium in Chile concludes that a one-percentage-point-of-GDP reduction in the fiscal deficit raises the trade surplus by at most 0.29 percentage points of GDP. This result reflects the consequences of an average fiscal retrenchment consistent implicitly with a mix of lower taxes, seigniorage and debt issuance -- as well as induced macroeconomic general-equilibrium effects -- representative for the 1960-1988 period upon which the underlying econometric estimation is based.

³³ The opposing influence on the saving-investment balance of intertemporal substitutability in consumption and investment is analytically explored by Servén (1994). On the one hand, the fiscal contraction reduces investment (as noted in the text), more so the smaller adjustment costs are. On the other hand, private consumption rises relative to output, and more so the higher the elasticity of intertemporal substitution in consumption, due to the anticipation of real appreciation along the adjustment path, which encourages substitution towards present consumption. Thus, both saving and investment decline, and the net effect on the current account is in principle ambiguous.

³⁴ Note that the ratio of the current account balance to output in Figure 4 shows the value of the current account balance in units of domestic goods (i.e., the product of the foreign-currency current account and the exchange rate) divided by domestic output. Hence this ratio reflects real exchange rate movements. Although the initial and final steady-state values of the current account must be the same in foreign currency units, the final steady-state level of the domestic-currency current account ratio is larger in magnitude than the initial level due to the accompanying real exchange rate depreciation.

Consider now the TU fiscal contraction that hits the economy from periods 1 to 4. For the effects of temporary shocks, the role of liquidity-constrained consumers and investors is crucial. If all consumers were unconstrained and forward-looking individuals, a temporary reduction in government consumption and taxation would lead only to a modest private consumption increase and hence would lead to a stronger temporary output decline and real exchange rate depreciation, than a permanent policy change. However, 45% of Chilean consumers are liquidity-constrained and hence respond to the temporary tax reduction by consuming more. Hence aggregate private consumption rises during the 4 periods, but by less than in the PU case analyzed above. Therefore output falls by more and the real exchange rate depreciates more on impact (by 0.86% more) and in the subsequent three periods than under the PU fiscal contraction.

In period 5, when the fiscal contraction is reversed, private consumption falls back to a level close to its steady-state value and a large real appreciation takes place. This 2.2% real appreciation between periods 4 and 5 reduces the domestic real interest rate by 1.1 pp in period 4, as the domestic interest rate is determined by forward-looking uncovered parity with the external rate. The low period-4 interest rate raises the human capital component (future labor income streams discounted at the domestic real interest rate) of private wealth, giving rise to a temporary aggregate-demand boost in period 4. As time passes between periods 1 and 4, private wealth increases and hence unconstrained consumers raise their consumption levels. This explains why output starts to recover and the real exchange rate starts to appreciate immediately after period 1.

Investment, responding to an increase in Tobin's q , increases on impact, and so the investment-output ratio peaks in period 1, increasing 0.8 pp over its initial steady state. This is in contrast to the decline in the investment ratio observed in the P case in period 1, when there is an impact decline in q .

The decline of output by 0.4% on impact is stronger than in the P case. The recession induced by the decline in aggregate demand is compounded by real-wage sluggishness. Over time, output recovers with the increase in consumption and the downward adjustment in the real wage up to period 4. Wages, influenced by present and past inflation, fall too slowly during periods 1-3 to ensure full employment and rise too little in period 5 to avoid temporary over-employment. In fact, employment and output show a similar pattern of a double cycle, with a trough in period 1, a peak in period 5, and subsequent oscillations toward the new steady-state full-employment levels. The highest employment deviations from full-employment are -0.2 pp in period 1 and +0.4 pp in period 5. An output spike is observed in period 5, when higher employment (as real wages are sluggish) allows output supply to accommodate the recovery in aggregate demand.

Inflation accommodates the forward-looking changes in money demand, falling to 13.7% in period 3, and showing a spike of 14.8% in period 5.

The current account-output ratio shows a strong cycle, closely following the patterns of consumption, the real exchange rate, and output.

It is important to note that there are significant steady-state effects when fiscal adjustment is permanent (PU) while they are almost negligible when it is temporary (TU). The reason is that the PU policy causes a permanent change in expenditure from domestic to imported goods, giving rise to a permanent real exchange rate depreciation of 1.33%, an output contraction of 0.44 pp (and thus a real wage that is 0.22% lower than its initial value), and higher consumption and investment ratios by 1.84 pp and 0.05 pp, respectively. Under a TU contraction, however, the changes in the public-private composition of aggregate spending are transitory too. Therefore final steady-state values are very close

to initial steady-state levels for all variables. The second-order differences are explained by the economy's transition path, which also affects steady-state values due to the model's hysteresis.

What is the contribution of a contractionary fiscal policy to a real exchange rate depreciation in Chile? Our results could be compared to those obtained by previous empirical studies on this question, summarized in Table 2. However, one should be fully aware of the limitations of such a comparison. First, only three results in Table 2 (those listed under 1, 2, and 3) are based on general-equilibrium models that consider fiscal financing and general-equilibrium feedback effects of fiscal policies. All other studies are based on reduced-form real-exchange-rate equations which follow widely varying specifications. Second, data definitions, samples, and frequencies, as well as estimation and calibration techniques, vary widely among these studies.

Bearing in mind these significant differences, results 2 to 9 show a wide range of short and long-term real exchange rate devaluations -- from zero to 2.5% -- in response to a one-percentage-point-of-GDP fiscal contraction. Our model results summarized in line 1, based on the distinction between impact and steady-state effects in a context of forward-looking expectations, show that a fiscal contraction contributes to a devaluation ranging between 1.0% and 1.4% in the short term and 0.67% and 0.01% in the long term, depending on how permanent the fiscal policy change is. Our 0.67% long-term real exchange rate devaluation resulting from a permanent fiscal contraction is close to the 0.8% obtained by Arrau *et al.* (1992) when using their general-equilibrium model.³⁵ And it is close to the mid-point of the wide range spanned by all other estimations, based on one-equation models. Our 1.0% impact devaluation effect is similar to three studies but differs significantly from three others.

3.4 Monetary Contraction: Towards International Inflation

Lowering domestic inflation toward international levels is an important policy objective in Chile, where inflation is stuck in the 11-14% annual range. Here we consider an orthodox policy package based exclusively on reducing monetary growth without any supportive income policies. This exercise likely represents therefore the upper bound of the short-term costs to be paid in terms of lost output and employment to achieve the benefit of a low long-term inflation level. We consider here an instantaneous halving of the money growth rate. Because the non-financial public sector is consolidated here with the central bank -- a reasonable assumption even for Chile where the government owns the central bank and is financially linked through transfers and profit remittances, although the bank is managed independently from the government -- the decline in inflation requires that conventional taxation is substituted for seignorage (and the inflation tax) as the means of paying for the unchanged level of government expenditure.

Ricardian liquidity-unconstrained consumers are indifferent between inflation and conventional taxation (that is neutral in our framework), whereas constrained or Keynesian consumers look solely at conventional taxation to determine their spending levels. The existence of the latter group is therefore one of the key causes for the monetary deceleration to have real effects.

³⁵ Due to the two-period OLG structure of the model by Arrau, Quiroz and Chumacero (1992), their temporary policy simulation is not comparable to ours. In their case a temporary policy shift implies a change that occurs in "period 1" (spanning an entire working life, say 30 years) and is reverted in "period 2" (spanning a retirement life). In our case, however, a temporary policy shift takes place for 4 years, being reverted in periods 5 and thereafter.

Table 2

**ESTIMATES OF PERCENTAGE REAL EXCHANGE RATE DEVALUATION EFFECTS
OF A REDUCTION IN PUBLIC SPENDING BY 1 PERCENTAGE POINT OF GDP IN CHILE**

	<u>Permanent Reduction</u>		<u>Temporary Reduction</u>	
	<u>Impact</u>	<u>Long-Term</u>	<u>Impact</u>	<u>Long-Term</u>
1. Our Model	1.0	0.67	1.4	0.01
2. Arrau et al. (1992), nontraded goods, with (w/o) liquidity constraints. (Calibrated Structural Model)	---	---	---	2.5 (1.3)
3. Arrau et al. (1992), traded and nontraded goods, with (w/o) liquidity constraints. (Calibrated Structural Model)	---	1.8 (0.8)	---	1.8 (1.0)
4. Marshall-Schmidt-Hebbel (1994) (Estim: 1960-1988)	1.1	1.1	---	---
5. Elbadawi-Soto (1994) (ECM Estim: 1960-92)	0.9	1.5	---	---
6. Arrau et al. (1992) (ECM Estim: 1977:2-1990:4)	1.3	0	---	---
7. Valdés et al. (1990) (Estim: 1960-1982)	0.2	0.2	---	---
8. Corbo (1983) (Estim: 1976-1983)	0.2	0.2	---	---
9. Le Fort (1988), Table 5, Prior 2 (Bayesian Estim: 1974:1-1982:4)	0.2	0	---	---

Note: Arrau et al. (1992) in results 2 and 3 report general-equilibrium simulation results based on a two-period life-cycle consumption model (with and without a group of liquidity-constrained consumers), parameterized for Chile, where a temporary (permanent) fiscal policy change means a period-1 (periods 1 and 2) shift. The other results are based on one-equation specifications for the real exchange rate, estimated by error-correction frameworks (5 and 6), standard econometric techniques (4, 7 and 8), or Bayesian estimations (9). Model results 2-4 and 6-8 are also summarized by Arrau et al.

The second central feature determining macro adjustment in response to monetary contraction in Chile is nominal wage inertia or indexation. Lower inflation raises real wages on impact, causing an output supply contraction and transitorily lower employment. As both demand and supply of national goods decline, the short-term effect on the real exchange rate is a priori ambiguous.

Consider first a PU monetary contraction, when the rate of monetary growth (nmg) is reduced permanently from 18.5% per year to 9.5%. Steady-state seignorage falls though not by the entire amount of the nmg decline because base money demand increases in response to lower inflation. Hence stationary seignorage revenue (on monetary base) falls from 0.5% of GDP to 0.3% of GDP, and tax revenue increases from 20.2% to nearly 20.4% of GDP (Figure 5).

Inflation follows a revealing pattern. The increase in money demand in response to lower permanent inflation is accommodated on impact by a massive decline in inflation, which is augmented by the temporary output fall in period 1. Hence inflation falls on impact to a negative level of -2%, well below the new steady-state rate of 5.0%, a figure close to international levels (Figure 6). Due to the forward-looking nature of this model -- that precludes the occurrence of capital gains from anticipated price jumps -- immediately after impact the inflation rate starts to converge from deflationary levels to the long-term steady-state level. The latter (5%) plus steady-state growth (4.5%) equals the new rate of money growth.

Due to Chile's strong backward-looking wage indexation, the aggregate supply contraction is much more severe than the contraction in aggregate demand. The massive decline in inflation in period 1 raises the real wage on impact by 1.2%. This causes a major employment contraction by 4.5 pp in period 1 (Figure 7). However, the deflation of period 1 causes the real wage increase to be reverted in period 2, contributing a fast recovery back to full employment. The real wage undershoots and employment overshoots in period 3, and subsequently both variables converge toward their steady-state levels.

On impact, the real interest rate jumps from 6.6% to 9.5% because the stickiness in real wages results in a 4.4 pp real exchange rate depreciation between periods 1 and 2. This lowers the human capital component of consumer wealth and hence consumption of non-constrained consumers contracts. Aggregate consumption falls by 0.6 pp. After period 1, consumption recovers, peaks in period 3, and converges toward the new steady state.

Investment, responding to Tobin's q , falls in period 1 by 0.19 pp, as q declines on impact by 18 pp. However, the fall in output in period 1 by 2.2 pp leads to a rise in the investment-output ratio by 0.15 pp (Figure 8). The overall effect on aggregate demand is a contraction in period 1.

After period 1, the real interest rate falls sharply as the real exchange rate depreciates toward its original level. The human capital component of wealth is increasing and thus consumption of unconstrained consumers is rising, beginning the transition to the new steady state. Investment is falling after period 1, as output recovers though Tobin's q recovers as well.

Since the supply contraction strongly dominates the demand contraction in period 1, the real exchange rate appreciates significantly by 4.4 pp (Figure 9). The one-period recession is significant (output falls by 2.2 pp), but less intense than the decline in employment. The reason is that higher intermediate imports (in response to the period 1 real appreciation) substitute for part of the unemployed labor. The subsequent evolution of output and the real exchange rate (with recovery in period 2 and peak

in period 3) mimics the pattern of employment, which illustrates the fact that both output and the real exchange rate are dominated by supply shifts.

The domestic-currency current-account ratio to output mimics to a large extent the pattern of the real exchange rate. The current account ratio improves on impact of the shock by 0.65 pp. After period 1, output recovers, and the current account ratio worsens and falls below both its original and final steady-state values before converging to the new steady state.

In the new steady state, the consumption ratio is 0.01 pp lower than in the initial steady state. The investment ratio and output are 0.002 pp and 0.018 pp, respectively, higher when compared with the original one. The real exchange rate is 0.06 pp more appreciated. Employment returns to its original steady-state level, so the higher output results in a 0.01 pp increase in the real wage.

It is interesting to compare the output response to a monetary contraction in our model with the effects simulated by a recent study on monetary disinflation and wage contracts for Chile by Jadresic (1994). Jadresic's model combines a wage equation that reflects the institutional set-up of overlapping labor contracts with strong wage indexation with a very simple closed-economy model in which output is determined by real money holdings. Normalizing our results to a 1-pp. contraction in monetary growth, we are able to compare both simulation studies in Table 3.

The dynamic pattern and the quantitative dimension of the output response to a permanent monetary contraction are similar in both studies. Output goes through a full cycle in periods 1-4. One slight difference is that after period 4, output converges from above asymptotically to its long-term equilibrium in our simulations, while it follows a sinoidal pattern in Jadresic's results. Our quantitative results are dampened in comparison to Jadresic's because we consider an open economy where changes in the real exchange rate allow a shift in the composition of productive inputs, which is ruled out in Jadresic's closed-economy set-up.

Table 3

ESTIMATES OF DYNAMIC OUTPUT EFFECTS OF A PERMANENT UNANTICIPATED
REDUCTION IN MONETARY GROWTH BY 1 PERCENTAGE POINT IN CHILE

(Percentage deviations from trend output levels, years after the policy change)

	Year 1	Year 2	Year 3	Year 4	Year 5	Long Run
1. Our Model	-0.25	0	+0.03	+0.02	+0.01	0
2. Jadresic (1994)	-0.41	0	+0.10	+0.01	-0.02	0

Consider now the effects of a permanent monetary contraction announced in period 1 to take place starting in period 3 (the PA case). The general qualitative features of macro adjustment in this simulation are similar to the above P case, but there is one main difference: because the monetary contraction to

take place in period 3 is already anticipated in period 1, adjustment in goods, asset and labor markets starts at the moment of the policy announcement. The adjustment is therefore spread over a larger period (2 additional years) and hence its intensity in each additional year is lessened.

The pattern of inflation illustrates the above point. Inflation starts falling in periods 1 and 2 (to an average 8%) as money demand starts increasing in anticipation of lower inflation that will be reached after the monetary contraction takes place in period 3.

With lower inflation and backward wage indexation, the economy experiences a recession in period 1, though it is considerably less intense than the recession following the first policy shift. Output falls by 1% and employment by 2%, with a recovery in period 2.

When the actual monetary contraction takes place in period 3, interestingly the inflation rate approaches its new steady-state level from above, which differs from the pattern of asymptotic convergence from below, observed in the PU case. This implies that the adjustment of the real wage (now with a peak in period 4) and employment, output, and the real exchange rate (all showing a trough in period 4) display a cyclical pattern opposite to the one observed in the P case. The same is true for consumption, investment and the current-account ratios.

In the new steady state, the consumption ratio is 0.01 pp higher than in the initial steady state. The investment ratio is 0.001 pp higher in the final steady state. Output is 0.02 pp higher in the new equilibrium, and the real exchange rate is 0.05 pp more appreciated. Higher output raises the demand for labor, which is reflected by a 0.01 pp increase in the real wage.

Lastly, consider the temporary unanticipated (TU) shock lasting periods 1 to 4, with all agents knowing that the contraction of the growth rate of the money supply will be reverted in period 5. Hence money demand is raised significantly at the beginning of period 1, consistent with a strong decline in inflation to 0.8% on impact of the shock. Afterwards, there is a continuous reduction in money demand, consistent with the anticipated convergence of inflation to its new (and old) steady-state level of 14%.

Due to backward indexation, the real wage peaks on impact and then declines strongly to a trough in period 6. This initial increase contributes to a significant recession in period 1 (output falls by 1.8 pp and employment by 3.5 pp), almost as intense as the PU case. Subsequently the economy recovers, however unlike the PU case, employment and output peak in period 6, when real wages are lowest.

The response of the real exchange rate and the current account ratio are more dampened than in the PU case, with the former appreciating by 3.2 pp and the latter improving by 0.5 pp in period 1.

Finally note that the contractionary monetary policy simulated here -- for all three cases -- does not entail any permanent resource transfer from the public to the private sector, unlike the PU change in government spending considered in section 4.1. This explains why the final and initial steady states are so similar under a monetary policy change. Any differences are only due to the influence of the specific transition path toward the new stationary equilibrium, reflecting the model's hysteresis property.

We conclude that achieving significantly lower long-term inflation can have substantial costs when it is based on an orthodox monetary contraction in an economy where backward indexation is important. Because we have only considered that wages are indexed to current and past inflation (using parameters

based on Chile's historical wage behavior) without considering other forms of indexation in non-tradable goods and in financial markets, we think that the short-term output and employment costs simulated here could be considered a lower-range estimate of the costs in Chile's highly indexed economy.

Two final points are worth underscoring. First, by pointing out the short-term costs of an orthodox (and massive) monetary contraction we have not answered the question about the net benefits of such a program, which are hard to address in a framework based on representative agents. Second, we are not able to compare this anti-inflation policy exercise with an alternative program based on a more gradualist approach combined with supportive income and exchange rate policies.

4. CONCLUSIONS

This paper has developed a dynamic general equilibrium model for the open economy. It is distinct in comprising several desirable features: nominal wage rigidity (allowing temporary deviations from full employment), groups of liquidity-constrained consumers and firms, import content of capital goods, and monetary financing of budget deficits. At the same time, the model allows for market clearing in goods and asset markets reflecting optimizing forward-looking behavior based on microanalytic foundations. The model's solution assures convergence to a dynamically stable steady-state equilibrium. The model is parameterized to represent the Chilean economy, making use of econometrically estimated parameter values and a calibration of behavioral equations and budget constraints to approximately fit the Chilean data for 1992.

Among Chile's macroeconomic policy issues of continuing relevance, this paper has addressed two questions. The first refers to the possible contribution of additional fiscal adjustment to macroeconomic adjustment in general and a more competitive exchange rate in particular. The second is about the macroeconomic effects of reducing inflation from double to single-digit levels. The model was applied to simulate the impact, transitional, and steady-state effects of anticipated and unanticipated, permanent and temporary policy shifts -- a task made possible by the model's explicit forward-looking solution.

The fiscal contraction (lower public consumption of national goods matched by lower taxation so that the government's budget remains balanced) shifts wealth from the public to the private sector, raising private consumption. Aggregate expenditure on national goods falls, while aggregate expenditure on imported goods increases and hence the real exchange rate depreciates. When the fiscal contraction is permanent, the impact devaluation is 1.0% for each percentage-point-of-GDP reduction in public consumption -- slightly larger than the 0.67% steady-state devaluation. However, when the fiscal contraction is temporary, the impact devaluation is larger (1.4%) but almost zero in the long term. A small long-run output decline and some temporary unemployment result from the permanent fiscal contraction.

Due to backward wage indexation, monetary policy has a much stronger effect on short-term output and employment than fiscal policy. The paper suggests that trying to achieve a reduction in inflation from 14% to 5% based on a cold-turkey approach that halves monetary growth (compensated by slightly larger conventional taxation to leave public spending unaltered) -- not supported by income policies or elimination of backward-looking wage indexation -- has stiff short-run costs. On impact of the policy shift, inflation disappears, to start subsequently to converge back toward its long-term equilibrium level. Due to Chile's strong backward-looking wage indexation, real wages rise substantially on impact, causing a 4.5% decline in employment and a 2.2% output slump during the first year.

Subsequently an output and employment cycle develops -- of an intensity and frequency that depend on how permanent the monetary policy change is -- that vanishes after some years when the economy reaches its new (similar to its old) stationary full-employment equilibrium.

We conclude that applying a full-scale general-equilibrium model based on an explicit forward-looking solution consistent with a stable steady-state equilibrium provides useful insights into the dynamic effects of macroeconomic policies. Having said this, we also acknowledge that the numerical results shown here are a reflection of our particular model specification and parameterization and hence should be taken with caution. Both specification and parameterization of our model could be refined in future work. Allowing for a more differentiated production structure -- distinguishing for instance between non-traded and traded goods, and between importables and exportables -- would allow to distinguish the real exchange rate from the terms of trade and to disentangle resource allocation effects in response to macroeconomic policy changes. Future parameterizations for the Chilean economy could be based on a larger sample of post-reform data less contaminated by structural breaks.

REFERENCES

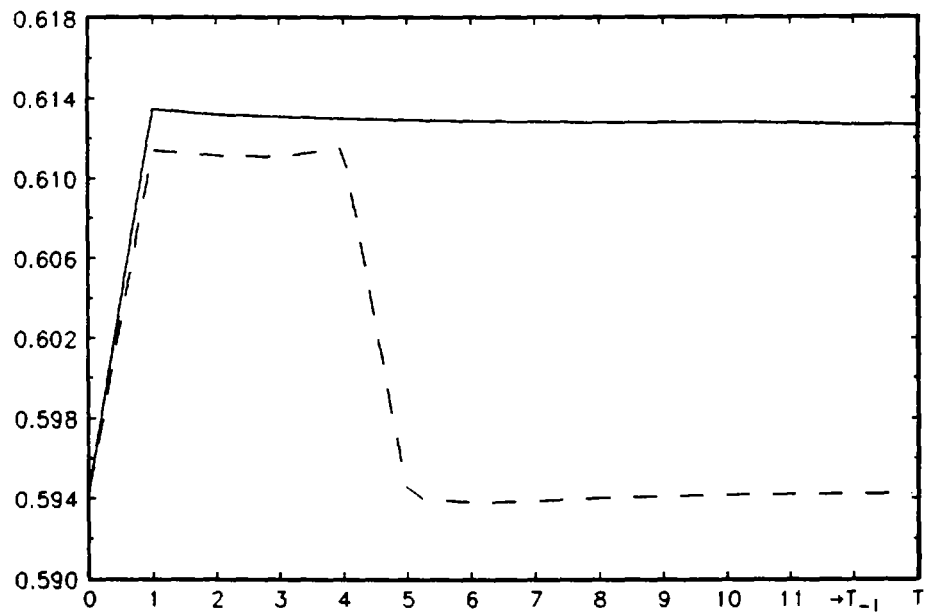
- Arrau, P (1989): "Intertemporal Monetary Economics: Evidence from the Southern Cone of Latin America", Ph.D. Dissertation, University of Pennsylvania, Philadelphia.
- Arrau, P., J.A. Quiroz, and R. Chumacero (1992): "Ahorro Fiscal y Tipo Cambio Real", Cuadernos de Economía 88, 349-86.
- Barro, R. (1974): "Are Government Bonds Net Wealth ?", Journal of Political Economy 82, 1095-117.
- Bernheim, B. (1987): "Ricardian Equivalence: an Evaluation of Theory and Evidence", in S. Fischer (ed.): NBER Macroeconomics Annual, MIT Press, 263-304.
- Blanchard, O. (1985): "Debt, Deficits, and Finite Horizons", Journal of Political Economy 93, 223-47.
- Blanchard, O. and C. Kahn (1980): "The Solution of Linear Difference Models Under Rational Expectations", Econometrica 48, 1305-11.
- Bosworth, B., R. Dornbusch, and R. Labán (eds.) (1994): The Chilean Economy. Washington D.C.: Brookings Institution.
- Bruno, M. and J. Sachs (1985): Economics of World-Wide Stagflation. Cambridge, MA: Harvard University Press.
- Buiter, W. (1984): "Saddlepoint Problems in Continuous Time Rational Expectations Models: A General Method and Some Macroeconomic Examples", Econometrica 52, 665-80.
- Cagan, P. (1956): "The Monetary Dynamics of Hyperinflation", in M. Friedman (ed.): Studies in the Quantity Theory of Money. Chicago, IL: University of Chicago Press.
- Central Bank of Chile: Boletín Mensual, various issues.
- _____: Indicadores Económicos y Sociales 1960-1988.
- Corbo, V. (1983): "International Prices, Wages and Inflation in an Open Economy: A Chilean Model", Review of Economics and Statistics 57, 564-73.
- Corbo, V. and S. Fischer (1994): "Lessons from the Chilean Stabilization and Recovery", in B. Bosworth, R. Dornbusch, and R. Labán (eds.): The Chilean Economy. Washington D.C.: Brookings Institution.
- Edwards, S. and A. Cox-Edwards (1987): Monetarism and Liberalization. Chicago, IL: University of Chicago Press.
- Elbadawi, I. and K. Schmidt-Hebbel (1991): "Macroeconomic Structure and Policy in Zimbabwe", PRE Working Paper No. 771, The World Bank, September.
- Elbadawi, I. and R. Soto (1994): "Capital Flows and Long-Term Equilibrium Real Exchange Rates in Chile", Policy and Research Working Paper 1306, The World Bank, June.
- Fair, R. and J. Taylor (1983): "Solution and Maximum Likelihood Estimation of Dynamic Nonlinear Rational Expectations Models", Econometrica 51, 1169-85.
- Gavin, M. (1991): "Economic Policy, Exchange Rates and Investment in a Keynesian Economy", manuscript, Columbia University.
- Giavazzi, F., M. Odekon, and C. Wyplosz (1992): "Simulating an Oil Shock with Sticky Prices", European Economic Review 18, (1/2) 11-39.
- Giavazzi, F and C. Wyplosz (1984): "The Real Exchange Rate, The Current Account, and The Speed of Adjustment", in C. Bilson and R. Marston (eds.), Exchange Rates: Theory and Policy. Chicago, IL: Chicago University Press.

- _____. (1985): "The Zero Root Problem: A Note on the Dynamic Determination of the Stationary Equilibrium in Linear Models", Review of Economic Studies 52, 353-7.
- Hayashi, F. (1982): "Tobin's Marginal q and Average q: A Neoclassical Interpretation", Econometrica 50, 215-24.
- _____. (1985): "Tests for Liquidity Constraints: A Critical Survey", NBER Working Paper No. 1720.
- Hayashi, F. and T. Inoue (1991): "The Relation Between Firm Growth and q with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms", Econometrica 59, 731-53.
- Hubbard, G. and K. Judd (1986): "Liquidity Constraints, Fiscal Policy and Consumption", Brookings Papers on Economic Activity, 1-59.
- Jadresic, E. (1994): "Inflación, Nivel de Actividad y Contratos Salariales en Chile", manuscript, presented at the Chile Inflation Seminar, Baños El Corazón, Chile, November.
- LeFort, G. (1988): "The Relative Price of Nontraded Goods, Absorption, and Exchange Rate Policy in Chile", IMF Staff Papers, 35 (2), 336-70.
- Leiderman, L. and M. Blejer (1988): "Modelling and Testing Ricardian Equivalence", IMF Staff Papers 35, 1-35.
- Lipton, D., J. Poterba, J. Sachs and L. Summers (1982): "Multiple Shooting in Rational Expectations Models", Econometrica 50, 1329-33.
- Lipton, D. and J. Sachs (1983): "Accumulation and Growth in a Two-Country Model", Journal of International Economics 15, 135-59.
- Lucas, R.E. (1967): "Adjustment Costs and the Theory of Supply", Journal of Political Economy 75, 321-34.
- Marshall, J. and K. Schmidt-Hebbel (1994): "Fiscal Adjustment and Successful Performance in Chile", in W. Easterly, C.A. Rodríguez, and K. Schmidt-Hebbel (eds.): Public Sector Deficits and Macroeconomic Performance. Oxford University Press.
- McKibbin, W.J. and J. Sachs (1989): "The McKibbin-Sachs Global Model: Theory and Specification", NBER Working Paper No. 3100.
- McKibbin, W.J. and M.W. Sundberg (1990): "Macroeconomic Linkages Between the OECD and the Asia-Pacific Region", Brookings Discussion Papers in International Economics, No. 80.
- McKibbin, W.J. and P.J. Wilcoxon (1992): "G-CUBED: A Dynamic Multi-Sector Equilibrium Model of the Global Economy (Qualifying the Costs of Curbing CO₂ Emissions)", Brookings Discussion Papers in International Economics, No. 98.
- Morandé, F.G. and K. Schmidt-Hebbel (eds.) (1988): Del Auge a la Crisis de 1982: Ensayos sobre Liberalización Financiera y Endeudamiento en Chile. Santiago: Instituto Latinoamericano de Doctrina y Estudios Sociales.
- Ramsey, F. (1928): "A Mathematical Theory of Saving", Economic Journal 38, 543-59.
- Sachs, J. (1983): "Energy and Growth under Flexible Exchange Rates: A Simulation Study", in J.S. Bhandari and B.H. Putnam (eds.): Economic Interdependence and Flexible Exchange Rates, Cambridge, MA: MIT Press.
- Schmidt-Hebbel, K. (1987): "Foreign Shocks and Macroeconomic Adjustment in Small Open Economies", Ph.D. Dissertation, Massachusetts Institute of Technology, Cambridge, Mass.
- Schmidt-Hebbel, K. and L. Servén (1994a): "Fiscal Policy in Classical and Keynesian Open Economies", PRD Working Paper No. 1299, The World Bank, May.
- Schmidt-Hebbel, K. and L. Servén (1994b): "Dynamic Response to External Shocks in Classical and Keynesian Economies", PRD Working Paper No. 1300, The World Bank, May.

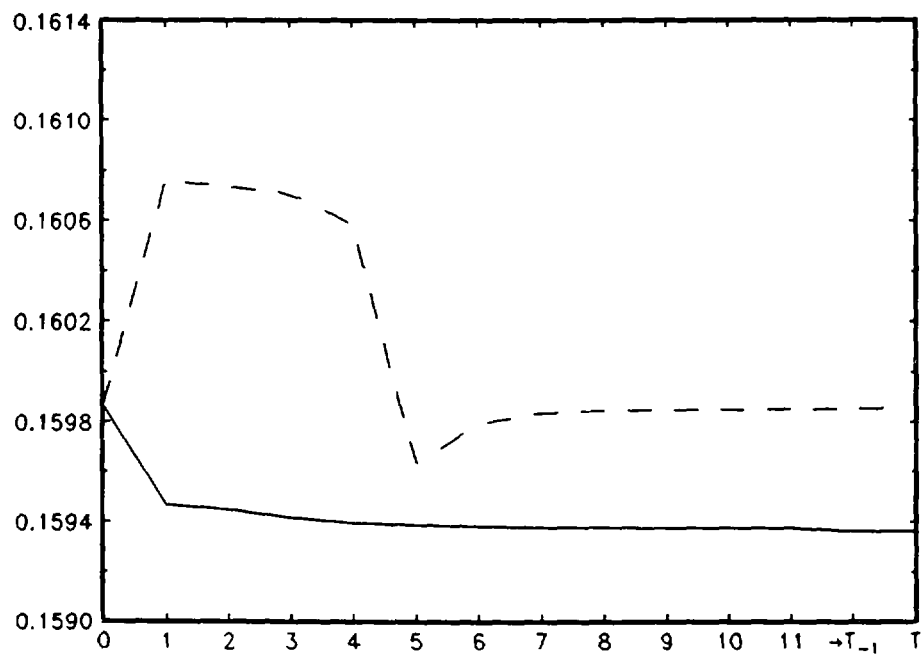
- Schmidt-Hebbel, K. and L. Serven (1994c): "Successful Structural Adjustment: Consumption and Growth in Chile", manuscript, The World Bank.
- Schmidt-Hebbel, K. and L. Serven (1995): "Dynamic Response to External Shocks in Classical and Keynesian Economies", in D. Currie and D. Vines (eds.): North-South Linkages and International Macroeconomic Policy, Cambridge: Cambridge University Press, forthcoming.
- Seater, J. (1993): "Ricardian Equivalence", Journal of Economic Literature XXXI, 142-90.
- Serven, L. (1994): "Capital Goods Imports, the Real Exchange Rate, and the Current Account", PRD Working Paper No. 1298, The World Bank, May.
- Serven, L. (1991): "Anticipated Real Exchange Rate Changes and the Dynamics of Investment", paper presented at the 1991 Latin American meeting of the Econometric Society, Uruguay, August.
- Serven, L. and A. Solimano (1991): "An Empirical Macroeconomic Model for Policy Design: The Case of Chile", PRE Working Paper 709, The World Bank, June.
- Tobin, J. (1969): "A General Equilibrium Approach to Monetary Theory", Journal of Money, Credit and Banking 1, 15-29.
- Treadway, A. (1969): "On Rational Entrepreneurial Behaviour and the Demand for Investment", Review of Economic Studies 36, 227-39.
- Turnovsky, S. and P. Sen (1991): "Fiscal Policy, Capital Accumulation, and Debt in an Open Economy," Oxford Economic Papers 43, 1-24.
- Valdés, A., E. Muchnik, and H. Hurtado. (1990): "Trade, Exchange Rate, and Agricultural Pricing Policies in Chile", Volume 1 (The Country Study), The World Bank Comparative Studies, February.
- Wildasin, D. (1984): "The q Theory of Investment with Many Capital Goods", American Economic Review 74, 203-10.
- World Bank (1991): World Development Report. New York: Oxford University Press.

Figure 1

Fiscal Contraction
Private Consumption/Output

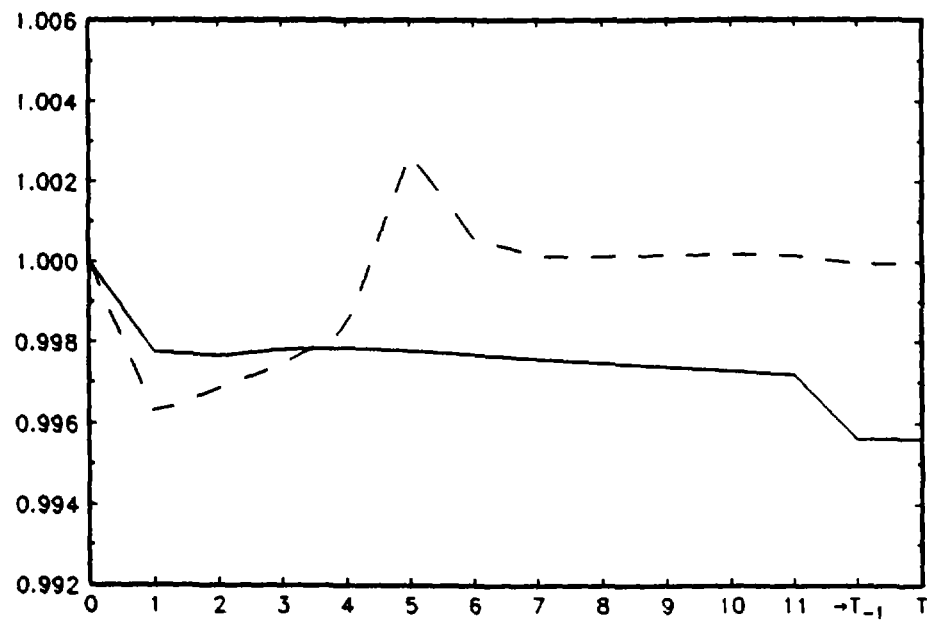


Private Investment/Output



— Permanent
- - - Transitory Unanticipated

Figure 2

Fiscal Contraction
Output

Real Exchange Rate

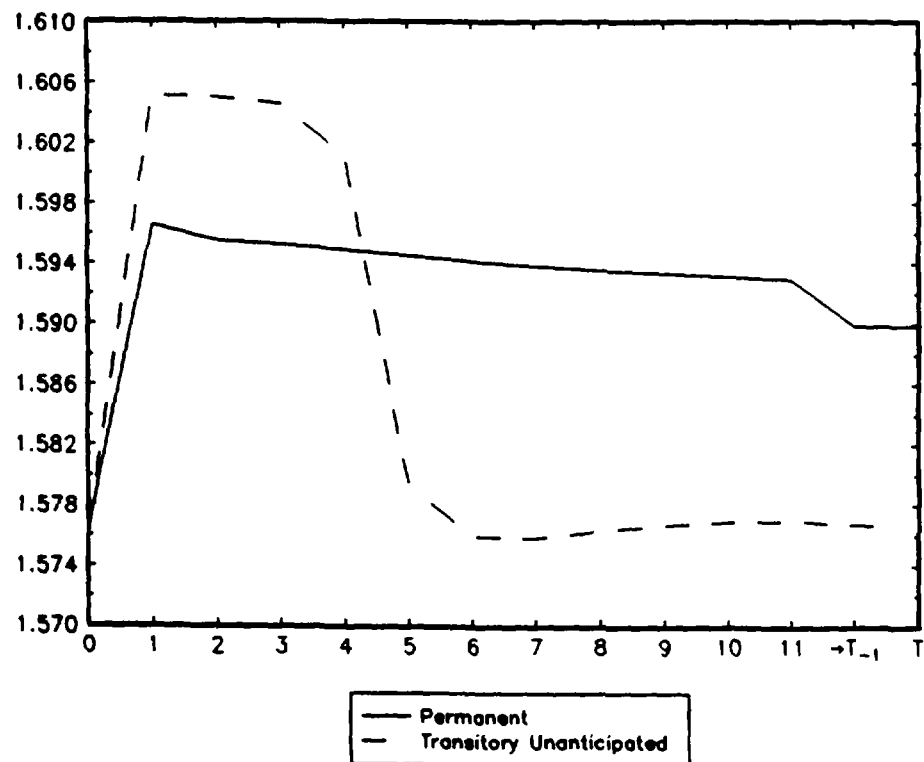
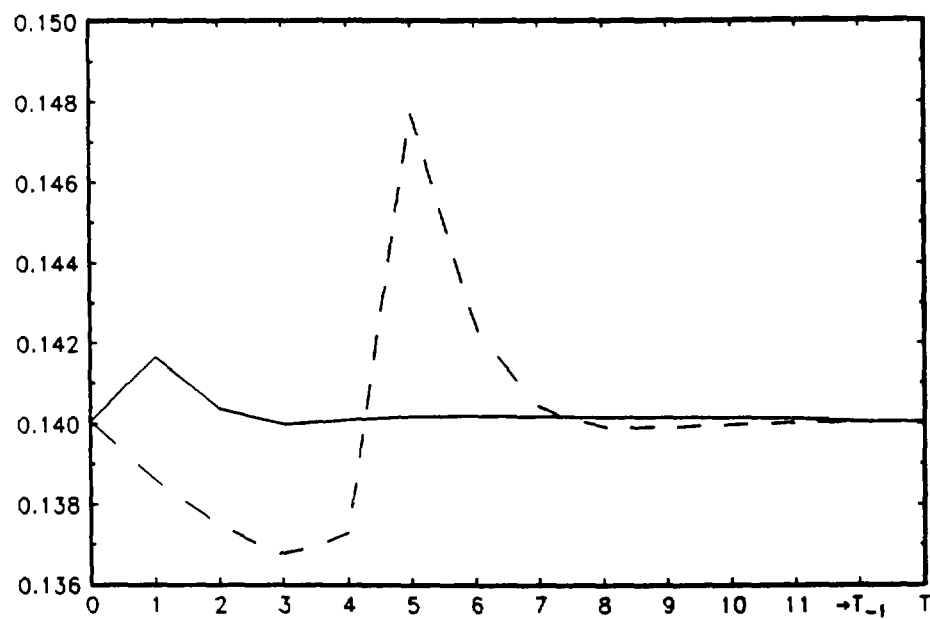
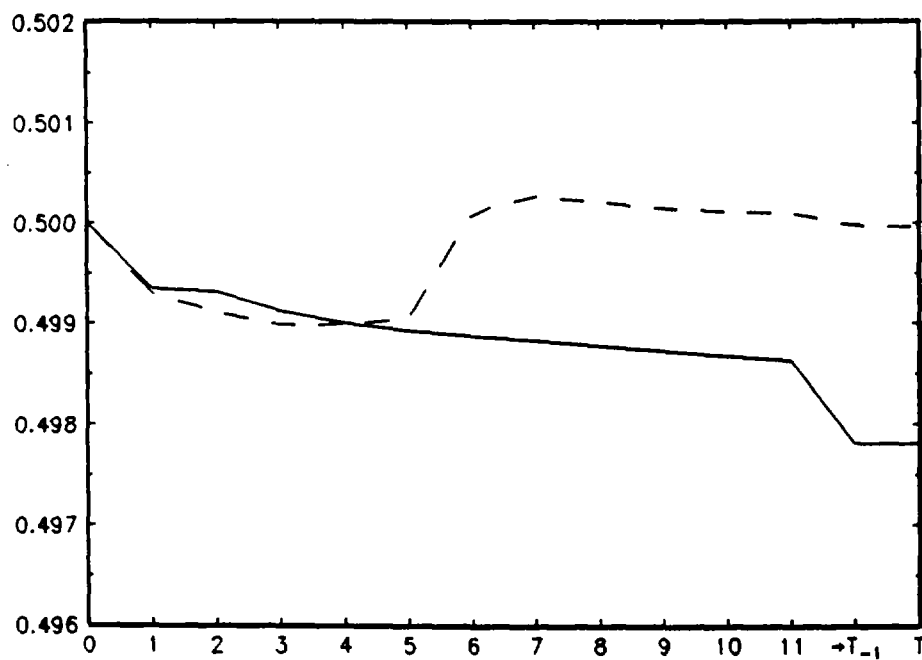


Figure 3

Fiscal Contraction
Inflation Rate

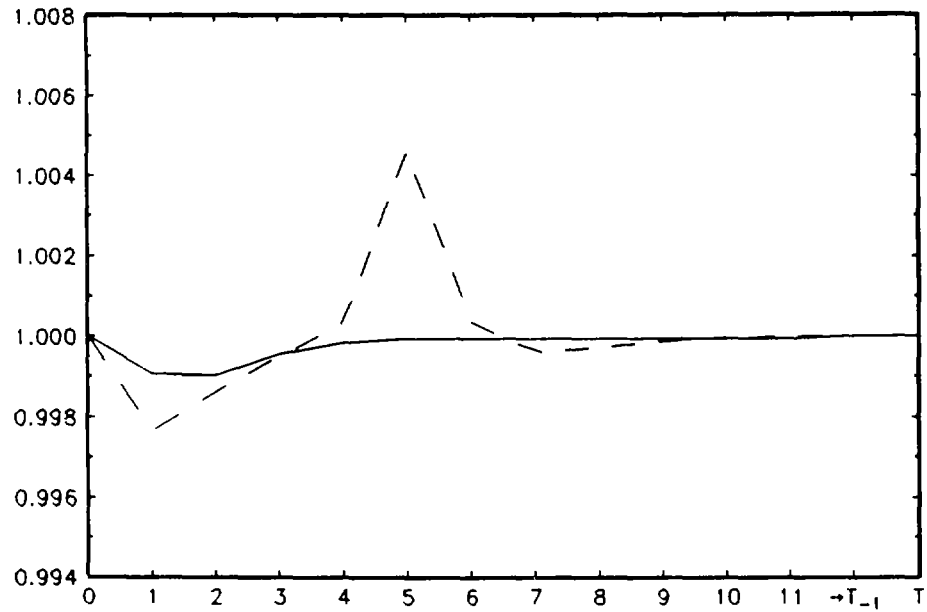


Real Wage

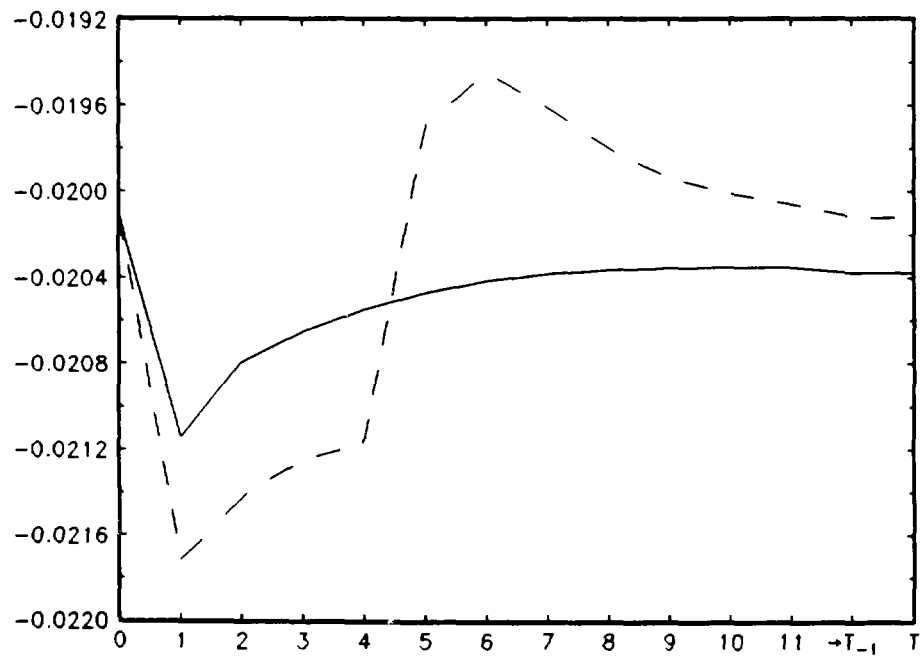


— Permanent
- - - Transitory Unanticipated

Figure 4

Fiscal Contraction
Employment

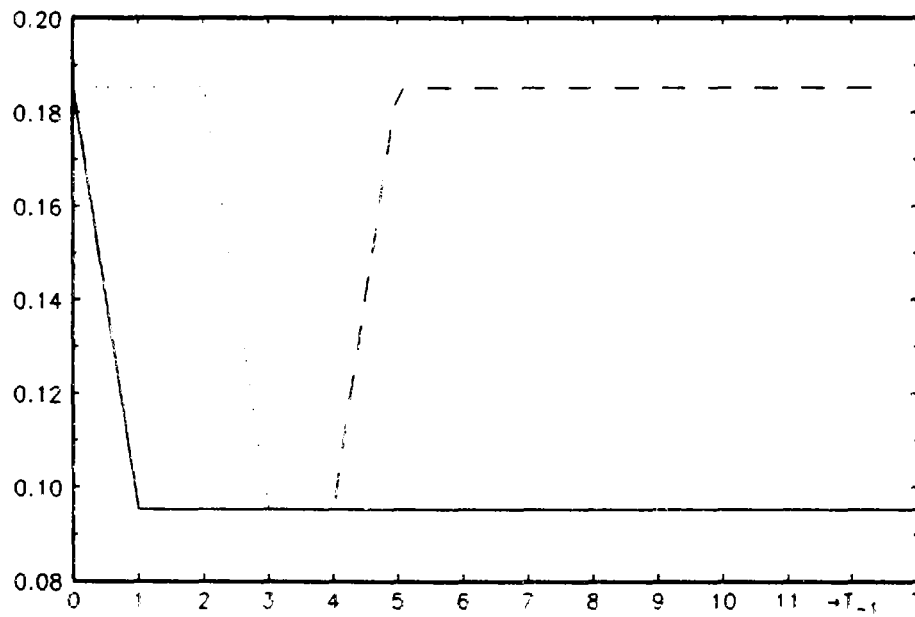
Current Account Balance/Output



— Permanent
- - - Transitory Unanticipated

Figure 5

Monetary Contraction
Money Growth



Tax Revenue/Output

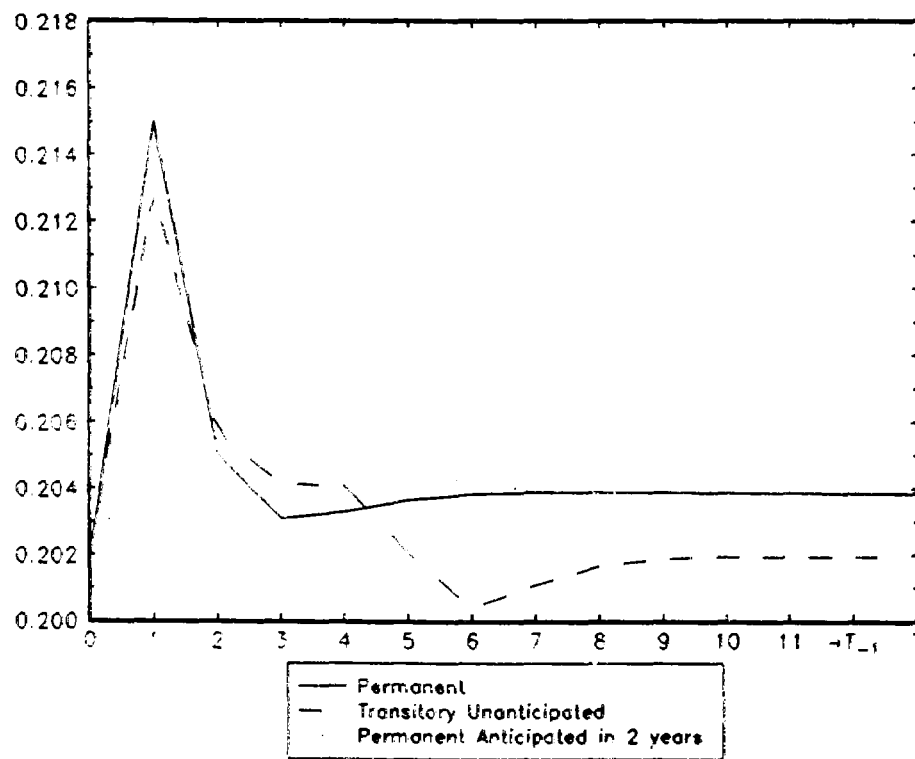
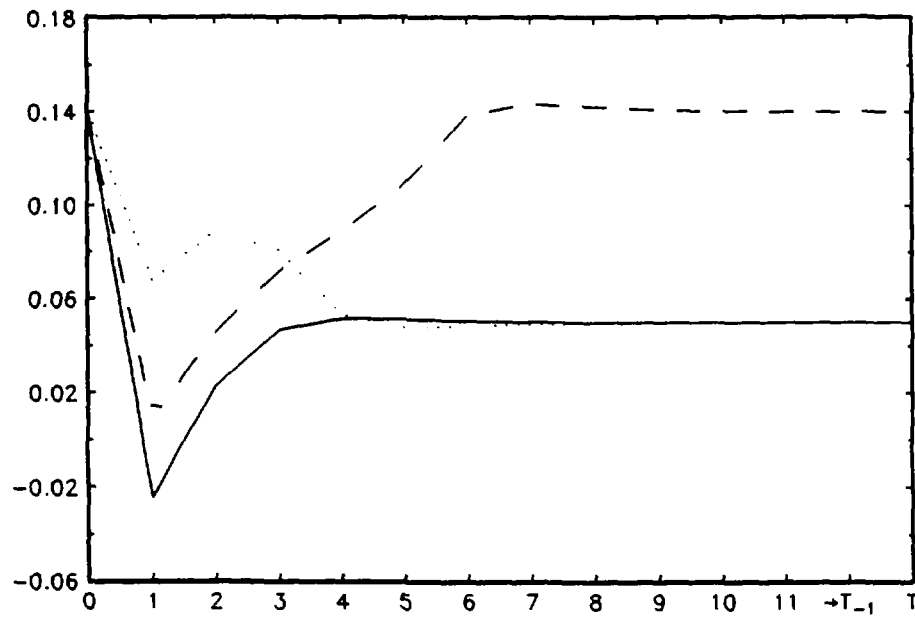


Figure 6

Monetary Contraction
Inflation Rate



Real Wage

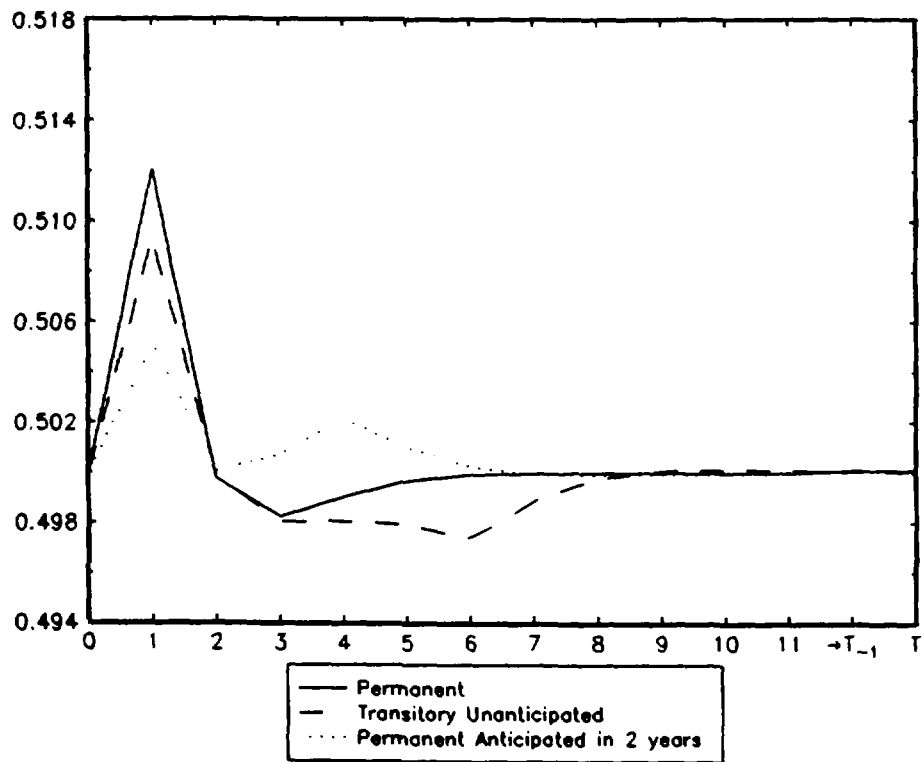
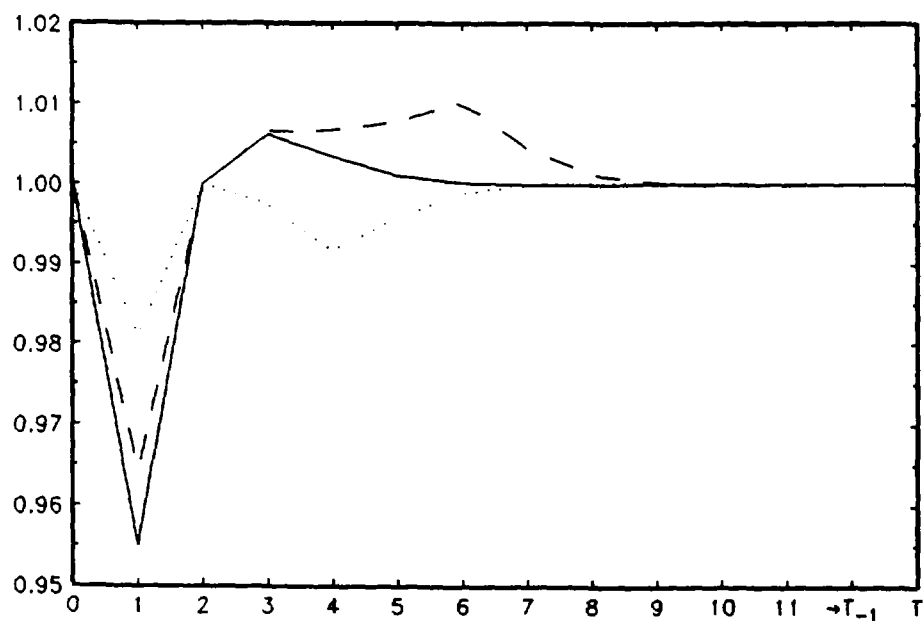


Figure 7

Monetary Contraction
Employment



Private Consumption/Output

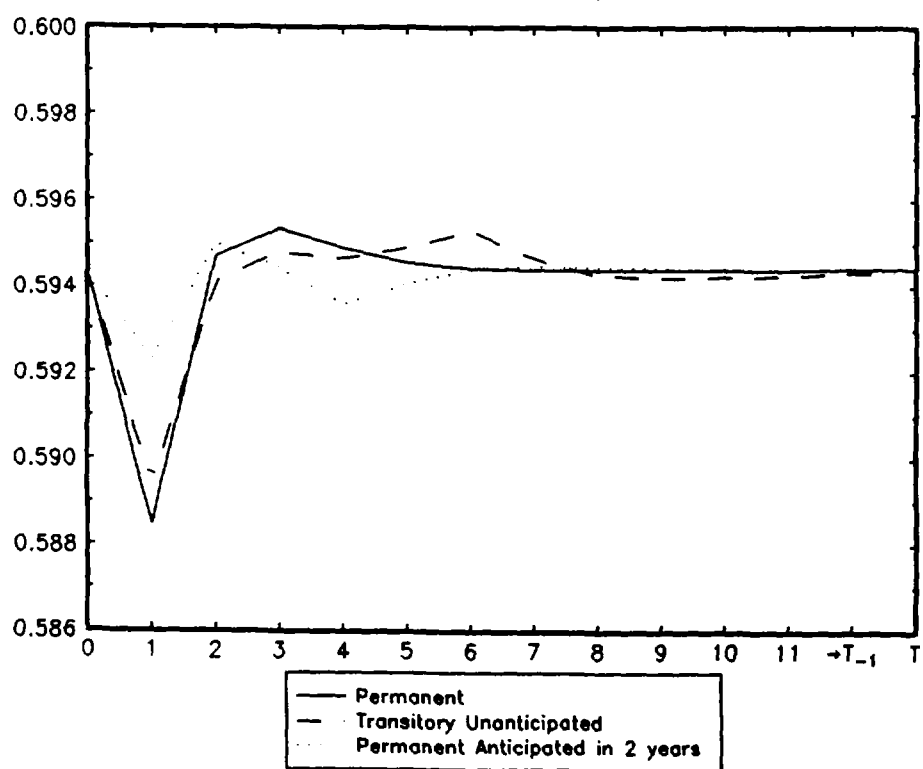
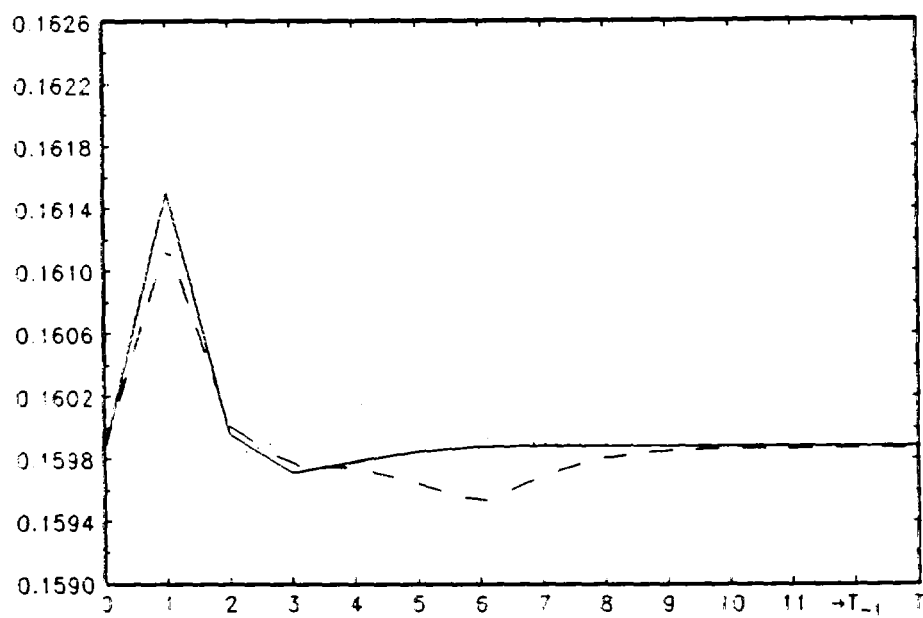


Figure 8

Monetary Contraction
Private Investment/Output



Output

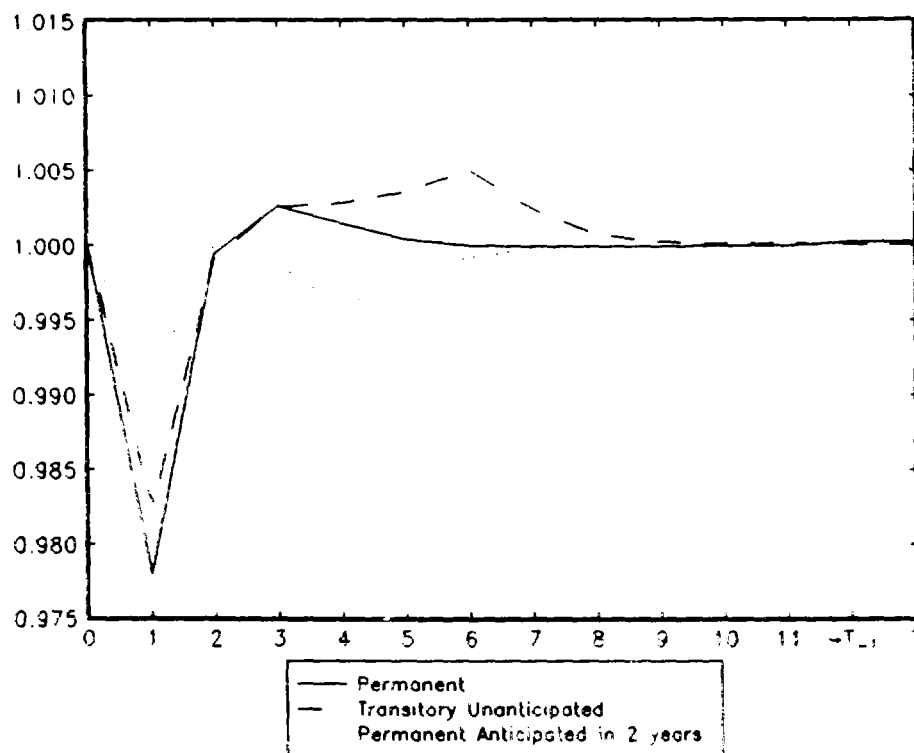
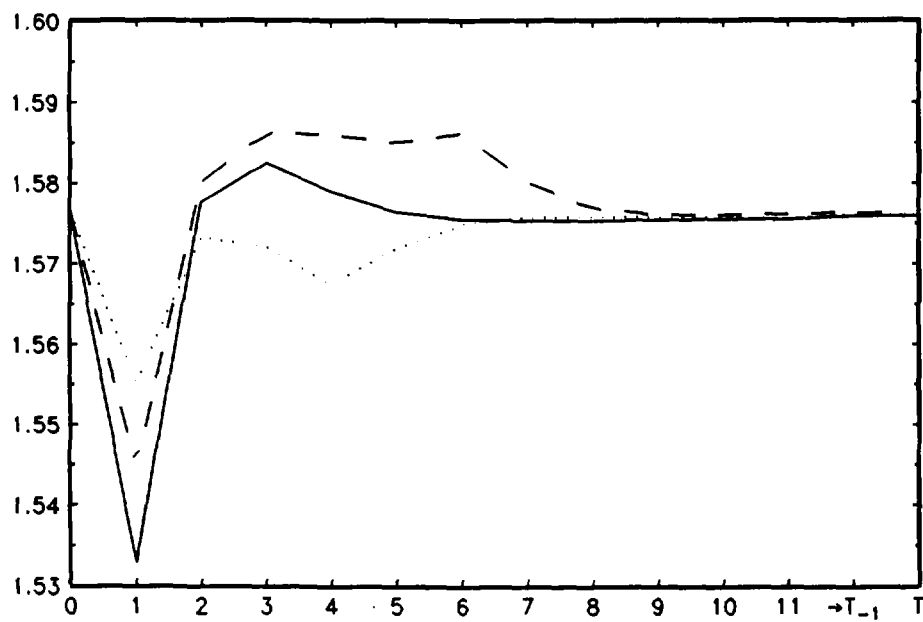
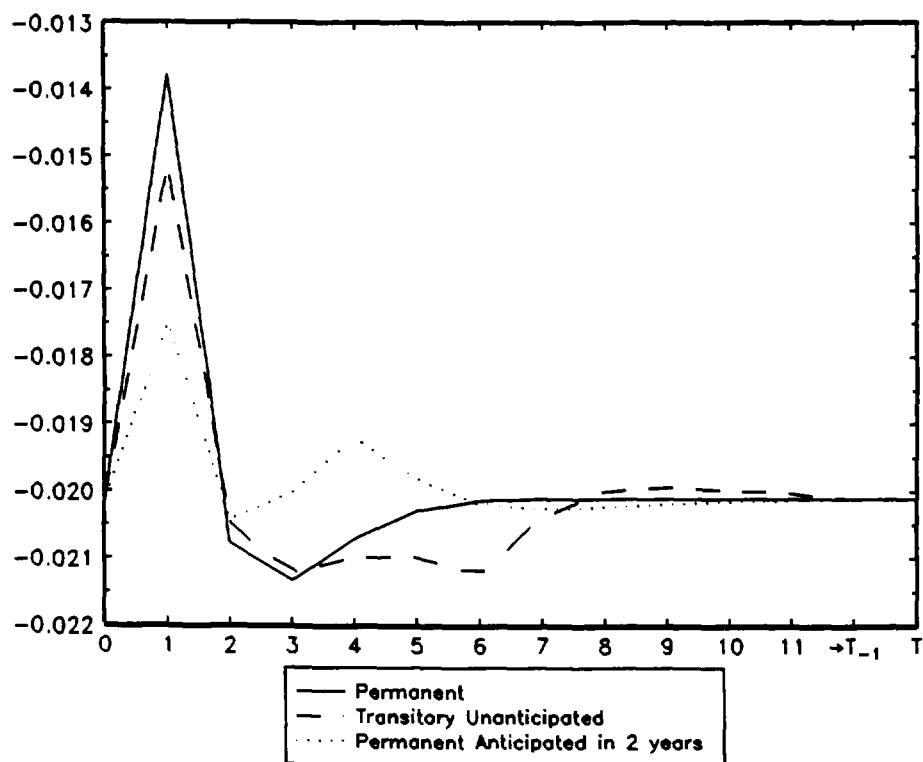


Figure 9

Monetary Contraction
Real Exchange Rate



Current Account Balance/Output



Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1450	Social Safety Net and the Poor during the Transition: The Case of Bulgaria	Fareed M. A. Hassan R. Kyle Peters, Jr.	May 1995	F. Smith 36072
WPS1451	Tunisia's Insurance Sector	Dimitri Vittas	May 1995	P. Infante 37642
WPS1452	The 1985–94 Global Real Estate Cycle: Its Causes and Consequences	Bertrand Renaud	May 1995	R. Garner 37670
WPS1453	Air Pollution and Mortality: Results from Santiago, Chile	Bart Ostro Jose Miguel Sanchez Carlos Aranda Gunnar S. Eskeland	May 1995	C. Bernardo 37699
WPS1454	Child Labor: A Review	Christiaan Grootaert Ravi Karbur	May 1995	M. Youssef 34614
WPS1455	Tentative First Steps: An Assessment of the Uruguay Round Agreement on Services	Bernard Hoekman	May 1995	F. Hatab 35835
WPS1456	Equity Markets, Transaction Costs, and Capital Accumulation: An Illustration	Valerie R. Bencivenga Bruce D. Smith Ross M. Starr	May 1995	P. Sintim-Aboagye 38526
WPS1457	Does Decentralization Increase Spending on Public Infrastructure?	Antonio Estache Sarbjit Sinha	May 1995	WDR 31393
WPS1458	Credit Policies: Lessons from East Asia	Dimitri Vittas Yoon Je Cho	May 1995	P. Infante 37642
WPS1459	Pension Funds in Central Europe and Russia: Their Prospects and Potential Role in Corporate Government	Dimitri Vittas Roland Michelitsch	May 1995	P. Infante 37642
WPS1460	Efficiency and Equity Considerations in Pricing and Allocating Irrigation Water	Yacov Tsur Ariel Dinar	May 1995	C. Spooner 32116
WPS1461	Stock Market Development and Firm Financing Choices	Asli Demirgüç-Kunt Vojislav Maksimovic	May 1995	P. Sintim-Aboagye 38526
WPS1462	Stock Market Development and Financial Intermediaries	Asli Demirgüç-Kunt Ross Levine	May 1995	P. Sintim-Aboagye 38526
WPS1463	Rural Nonfarm Employment: A Survey	Jean O. Lanjouw Peter Lanjouw	May 1995	J. Shafer 85581

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1464	How Does the North American Free Trade Agreement Affect Central America?	Edward E. Leamer Alfonso Guerra Martin Kaufman Boris Segura	May 1995	S. Vallimont 37791
WPS1465	Post Trade Liberalization Policy and Institutional Challenges in Latin America and the Caribbean	Sarath Rajapatirana	May 1995	J. Troncoso 37826
WPS1466	Ownership and Financing of Infrastructure: Historical Perspectives	Charles D. Jacobson Joel A. Tarr	June 1995	WDR 31393
WPS1467	Beyond the Uruguay Round: The Implications of an Asian Free Trade Area	Jeffrey D. Lewis Sherman Robinson Zhi Wang	June 1995	B. Kim 82477
WPS1468	Government's Role in Pakistan Agriculture: Major Reforms are Needed	Rashid Faruquee	June 1995	C. Anbiah 81275
WPS1469	The Role of Labor Unions in Fostering Economic Development	John Pencavel	June 1995	WDR 31393
WPS1470	Pension Systems and Reforms: Country Experiences and Research Issues	Patricio Arrau Klaus Schmidt-Hebbel	June 1995	E. Khine 37471
WPS1471	Pension Reform and Growth	Giancarlo Corsetti Klaus Schmidt-Hebbel	June 1995	E. Khine 37471
WPS1472	Fiscal and Monetary Contraction in Chile: A Rational-Expectations Approach	Klaus Schmidt-Hebbel Luis Servén	June 1995	E. Khine 37471
WPS1473	The Surge in Capital Inflows to Developing Countries: Prospects and Policy Response	Eduardo Fernandez-Arias Peter J. Montiel	June 1995	
WPS1474	Are Stable Agreements for Sharing International River Waters Now Possible?	D. Marc Kilgour Ariel Dinar	June 1995	C. Spooner 32116
WPS1475	Decentralization: The Way Forward for Rural Development?	Andrew N. Parker	June 1995	D. Housden 36637
WPS1476	Public Spending and the Poor: What We Know, What We Need to Know	Dominique van de Walle	June 1995	C. Bernardo 37699
WPS1477	Cities Without Land Markets: Location and Land Use in the Socialist City	Alain Bertaud Bertrand Renaud	June 1995	L. Lewis 30539